

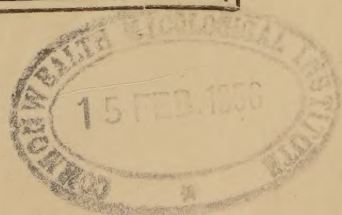


INDIAN CENTRAL JUTE COMMITTEE

**Annual Report of the Jute Agricultural
Research Institute (1954-55)**

Calcutta

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ANNUAL REPORT OF THE JUTE AGRICULTURAL RESEARCH INSTITUTE 1954-55.

Introduction

The farm consists of 105.6 acres of land of which 55 acres were under cultivation during the year under report. Experiments occupied about 33 acres of the cultivable area. Due to the differences in the gradient of the various plots, most of the farm area, which consists mainly of high land, was slightly eroded by rains. The plots became sandy and the fertility of the farm, as a whole, deteriorated. To facilitate the permanent layout of the experimental area and to reclaim most of the uncultivated land, a bulldozer was obtained from the Government of West Bengal; the work was practically completed. Experimental areas have been demarcated and farm roads have been laid out and as a result of reclamation 10 acres have been added to the original cultivable area. In spite of this, there is an acute shortage of suitable low land for double and triple cropping experiments with jute and paddy, green manuring and other trials as most of the reclaimed land consists of high and medium lands and the negotiations for acquiring 50 acres of low and medium lands adjacent to the farm are still in progress.

The labour situation on the farm showed some improvement. Retting facilities were also better as permission for using the canal adjacent to the farm for this purpose was obtained through the courtesy of the Executive Engineer, Irrigation Department, West Bengal. The completion of the construction of the bullock shed, implement shed, threshing floor and fibre godown also facilitated farm work.

The pilot scheme on "Extension of improved methods of jute cultivation" was continued during the year in the centres Barrackpore, Baraset and Basirhat.

Crops like mesta, roselle, sunn hemp, paddy, green manure crops etc., besides jute were grown and studied during the kharif and rabi seasons. Potato, mustard, linseed and pulses were also raised during the rabi season.

Season

The season was late and was not quite favourable for jute crop under Nilganj conditions. Land preparation could not be done timely on account of late rains. The double and triple cropping experiments which require to be sown early had to be dropped due to the late rains. The experimental sowings were delayed and could only be taken up from the 7th May. Shortly after this a drought set in and affected the early sown crops. Total precipitation recorded was 48.89 inches spread over a period of 103 days during the year under report. A prolonged drought towards the later part of July affected the crops considerably.

The attack of semilooper, mite and ring pest was widespread in the jute growing areas and necessary plant protection measures were taken wherever possible.

Development of the Jute Agricultural Research Institute

The ground floor of the Institute building and six "C" type, twelve "H" type and 20 "G" type quarters, the construction of which was completed last year, have since been supplied with electricity and water. The work in connection with gas and water fittings and bench work in the laboratories which was entrusted to the D. G. S. and D. last year has been only recently taken up. Most of the departments of the Institute have been shifted to the permanent building and the other sections will be shifted as soon as some progress is made in the work of fitting up the laboratories.

The construction work under the second phase consisting of the first floor of the Institute building, lecture hall, hostel and the remaining staff quarters has not yet been taken on hand as the administrative approval from the Government of India has not so far been received.

The Expert Sub-Committee appointed by the Indian Central Jute Committee recommended the establishment of six Research-cum-Development Substations in the jute growing states in

course of three years and fixed the order of priority. The Government of India have, however, recently informed that all the substations should be opened in 1955-56 and provided a sum of Rs. 15. 7 lakhs for this purpose. Suitable sites for the establishment of the substations in the different jute growing states are under consideration and negotiations for acquiring the land have been started in West Bengal, Assam, Bihar, Orissa and U. P.

Nucleus Jute Seed Multiplication Farm.—The seed farm could not be started this year as the piece of land measuring about 200 acres selected near Panagarh, District Burdwan, could not be made available by the Defence Department of the Government of India. An alternative site was selected in Midnapore district, but this land is also not yet available.

I. BREEDING AND GENETICS

1. Collection of Varieties and Types

86 indigenous samples of jute seeds, 64 *capsularis* and 22 *olitorius*, mostly collected from Tripura State were sown during the season. The growth performance of all of them was like that of cultivated types and composition studies revealed that many of them were heterogeneous in respect of pigmentation and maturity. 284 *capsularis* and 100 *olitorius* primary selections were made in the type plots, besides 2 *capsularis* and 8 *olitorius* selections from other promising materials. Of these 112 *capsularis* and 49 *olitorius* selections were carried forward.

12 exotic samples of seeds, four *capsularis* and eight *olitorius* were sown during the season. Of these, three *capsularis* samples were received from Belgian Congo and one from Eastern Nigeria. The seed samples from the former source gave very poor germination varying from 5 to 25 per cent while that from the latter failed to germinate. Of the *olitorius* samples, six were from Belgian Congo and they were found to have completely lost their viability ; of the remaining

two, one was received from Antalya Region, Turkey and the other from Uganda, East Africa ; their germination percentages were about 9 and 64 respectively. In addition, one sample of seeds of *C. tiniansis* received from Tinian and Saipan Islands, Mariana Islands, and another of an unknown species of *Corchorus* from Aden were found to have lost their viability completely.

The growth performance of the plants raised from the three *capsularis* samples from Belgian Congo and the *olitorius* sample from Uganda was like that of the cultivated types ; but the *olitorius* type from Turkey was intermediate between the wild and the cultivated types in respect of height and branching habit. The *olitorius* material from Uganda was a late type which flowered as late as November. One of the *capsularis* samples produced only green coppery red plants and both the *olitorius* samples produced only green plants indicating that these types were from pure stock. The remaining two *capsularis* samples, produced green as well as pigmented (green-coppery-red and coppery-red) plants. Seven *capsularis* and 15 *olitorius* selections were made in these exotic types of which only two *capsularis* and one *olitorius* were carried forward.

2. Breeding

Progeny-row tests.—Eight progeny-row trials, five *capsularis* and three *olitorius* were carried out. The *capsularis* trials included one first year trial, two second year trials, one third year trial and a trial of X-irradiated materials at the second year stage. The *olitorius* trials included one first year trial and two second year trials. Due to drought and soil heterogeneity, germination and final stand were very much affected in some of the experimental plots ; as a result yield data of one of the *capsularis* second year trials had to be rejected. Records of germination, pigmentation, periodical vigour performance, flowering, etc. were taken in all these trials. The trials were harvested culture-wise at small pod stage. A total of 4252 secondary selections, 3164 *capsularis* and 1088 *olitorius*, were

made. Pigmentation, height, base diameter, date of first flowering, etc. were recorded for individual selections.

First year test of selections : (i) *Capsularis*.—29 promising selections obtained from various sources, including a few from the X-irradiated materials of the 1953 season were tested in a replicated randomized block trial. 464 secondary selections were made for further studies. On the basis of analysis of the yield data eight promising cultures were carried forward.

(ii) *Olitorius*.—18 selections obtained from hybrid, X-irradiated and other materials were tested and 288 selections made for further studies. On the basis of analysis of the stand and yield data ten promising cultures, four early and six late, were carried forward.

Second year test of selection : (i) *Capsularis*.—14 families of five progenies each, 12 brought forward from the first year trials of the previous year and two from multiple crossing materials, were tested in two trials; the five non-branching materials being included in one trial and the nine branching materials in the other. The trials were harvested but as the germination and the final stand in some of the plots of the trial of the branching materials ranged from very poor to nil, it was decided to repeat the trial next year. On the basis of analysis of stand and yield data of the non-branching materials, two progenies from two families which were statistically as good as the control D154 were carried forward.

(ii) *Olitorius*.—10 families of five progenies each, brought forward from the first year trials of the previous year including hybrid, X-irradiated, exotic and indigenous materials were tested in two trials. Germination in the first trial, ranged from good to nil and in the other trial from good to poor. On the basis of the analysis, of stand and yield data eight progenies, six from three families of the first trial and two from one family of the second trial were carried forward. The rest of the progenies

of the two promising late families were bulked up for multiplication during the next season.

(iii) *Capsularis X-irradiated materials*.—10 families of five progenies each, carried forward from the *capsularis* X-ray (x_1) trial of the previous year were tested along with controls in a compact family block layout in eight replications. All the blocks could not be sown on the same day due to heavy rains and the sowing of the remaining portions could only be taken up after 13 days. The growth was fair and the trial was harvested for fibre. The stand and yield data of blocks I—IV and V—VIII, sown on different dates, were analysed separately. The results were inconclusive and the trial would be repeated with the best progenies of each family.

Third year test of selections.—Six families of five progenies each carried forward from the second year *capsularis* trials of the previous year were tested. Germination in the different plots ranged from good to poor and the growth was fair. The trial was harvested and on the results of analysis of the stand and yield data, one family was bulked up for large scale trial.

Varietal trials.—Two varietal trials, one *capsularis* and one *olitorius*, were carried out during the year.

(i) *Capsularis*.—The *capsularis* varietal trial was continued with the eight varieties, viz., JRC-212, JRC-13, JRC-321, JRC-1, JRC-918, JRC-919, Fanduk (early control) and D154 (late control). It may be mentioned here that the first six varieties are the same as C39-212, C41-13, C42-KJ-321, JR48-1, C.T.-918 and C.T.-919 respectively which have lately been renamed. The trial was sown in the first week of May. The germination ranged from fair to poor. The crop was affected by drought and attacks of semilooper and mites at the early stages of growth but it recovered from these damage at later stages and the ultimate growth in most of the plots was fair. The stand and yield data were analysed and the results of

analysis along with the dates of first flowering and quality ratios of the fibre of the different varieties are given below :—

TABLE I
Capsularis Varietal Trial

Layout—Randomized blocks in six replications.

Gross plot size—1/44 acre (33' × 30').

Effective plot size—1/58 acre (29' × 26').

Date of sowing—7-5-54. Harvested between 26-8-54 and 28-10-54 at small pod stage.

Variety	Yield per acre (Md)	Per cent on control	Date of first flower	Quality Ratio.
JRC-919	29.98	119.63	9.9.54	97 ± 2.1
JRC-212	25.90	103.35	17.8.54	71 ± 1.1
JRC-13	25.36	101.20	18.8.54	85 ± 1.2
D154	25.06	100.00	17.8.54	64 ± 1.3
Fanduk	23.17	92.46	3.8.54	85 ± 1.5
JRC-1	22.89	91.34	16.8.54	80 ± 1.2
JRC-918	20.89	83.36	19.8.54	83 ± 1.6
JRC-321	20.37	81.28	14.8.54	100 ± 1.4
P	0.01			
C.D.	4.41			
S.E.%	4.73			

From the table above it may be seen that JRC-919 has proved significantly superior to the control D154 giving about 20 per cent higher yield. JRC-212 giving about 3 per cent higher yield is statistically as good as the control. The early variety JRC-321 maintained its high quality ratio.

(ii) *Olitorius*.—The *olitorius* varietal trial was continued with the varieties JRO-632, JRO-753, JRO-620, R26 and C.G. The first three of the varieties are the same as O-40-632, O40-753 and O39-620 respectively which have recently been renamed. The trial was sown in the first week of May but as the germination was gappy and poor, it was resown in the first week of June. Germination was fair this time and the

performance of the crop satisfactory. The crop was affected by root-rot and white ants at the later stages of growth thus necessitating the early harvest of all the varieties except C.G. The stand and yield data were analysed. The results are given below along with the dates of first flowering and quality ratios of the fibres of the different varieties.

TABLE II

Olitorius Varietal Trial

Layout—5 × 5 latin square.

Gross plot size—1/50 acre (35' × 25').

Effective plot size—1/67 acre (31' × 21').

Date of sowing—5.6.54. Harvested on 8.9.54 at the small pod stage in the case of C.G. and flowering stage in the rest.

Variety	Yield per acre (Md)	Per cent on control	Date of first flower	Quality Ratio.
JRO-753	24.97	129.98	16.8.54	57 ± 1.0
JRO-632	24.10	125.46	16.8.54	82 ± 1.4
JRO-620	22.69	118.11	19.8.54	80 ± 1.4
C.G.	19.21	100.00	13.8.54	82 ± 0.6
R26	16.72	87.04	14.8.54	88 ± 1.2
P	0.01			
C.D.	1.12			
S.E.%	1.20			

The results obtained confirmed the findings of the previous years. The improved strains JRO-753, JRO-632 and JRO-620 evolved by this Institute proved to be significantly superior to the control C.G. yielding about 30, 25 and 18 per cent higher respectively.

Varietal trials in State farms.—12 varietal trials, six *capsularis* and six *olitorius* were allotted to the different State Farms in West Bengal, Bihar, Assam, Orissa and U.P. There were two *capsularis* and two *olitorius* trials in West Bengal and one trial each of *capsularis* and *olitorius* in the other

States. Besides, one *capsularis* trial in U.P. was sown under low land conditions and this trial included the promising early materials, viz., JRC-321, JRC-412 and Fanduk. All the trials were sown except one *olitorius* trial at the Chinsurah Farm (West Bengal), which could not be sown due to drought followed by incessant rain.

The *capsularis* varietal trial at Karimganj Farm (Assam) failed as the growth of the crop was very poor and stunted due to lack of proper interculture. The *olitorius* trial at the State farm at Dalgaon (Assam) was sown as late as 30th May, 1954; the growth of the crop was very poor due to heavy attack of semilooper at the early stages. Though the yield per acre was low, of analysis of the data, the improved strain JRO-632 proved significantly superior to the control, C.G. yielding about 22 per cent higher.

The *capsularis* varietal at Maynaguri farm (West Bengal) was sown on 11th April 1954. Germination ranged from good to poor and the growth of the crop was satisfactory. The trial was harvested and the stand and yield data were recorded. The data were rejected as all the varieties were not harvested at the same stage of maturity. The *capsularis* varietal trial at Cooch Behar (West Bengal) was sown on the 15th April, 1954. The germination was good and the growth of the crop was satisfactory. The trial was harvested between 21st August, 1954 and 25th September, 1954. The stand and yield data were analysed. The improved variety JRC-321, which is also an early type, proved significantly superior to the early control Fanduk yielding about 28 per cent higher and also gave 7 per cent higher yield than the late control D154 though both were statistically as good. The *olitorius* trial at the State Agricultural Farm at Berhampur (West Bengal) was sown as late as 10th June, 1954 and it failed as the germination was markedly gappy and the crop was very uneven.

Both the *capsularis* and the *olitorius* varietal trials in the State farm at Purnea (Bihar) failed as the germination was extremely gappy in some of the plots. The growth of the crop

was unsatisfactory due to lack of timely interculture. The crops were ploughed down.

The *capsularis* varietal trial at Kujang (Orissa) was sown as late as 20th June, 1954 ; besides, the trial was laid out on a piece of land of which the top soil in one rank (Blocks I-III) had been partly removed. The crop of this portion was very poor as compared to that of the other rank (Blocks IV—VI). Analysis of yield data was therefore restricted to Blocks IV—VI. JRC-212 proved significantly superior to the control D154 yielding 19 per higher. The *olitorius* trial at the State farm at Ballia (Orissa) failed and the crop was ploughed down.

The *capsularis* varietal trial at Gograghat, U.P. was carried out with the varieties, JRC-1, JRC-13, JRC-212, JRC-321, Fanduk and D154 (control). The trial was sown on 24th February, 1954 and harvested between 20th August, 1954, and 31st August, 1954. The results were analysed and there was no significant difference in yield between the different varieties.

The early varieties, Fanduk JRC-321 and JRC-412 were sown along with JRC-212, D154 and 'local' in the low land trial in the same farm on 7th March, 1954 and harvested on 12th August, 1954 and 13th August, 1954. Fanduk, D154, JRC-212 and JRC-321 were statistically as good but Funduk was significantly superior to the 'local' and JRC-412 at 1 per cent level.

The *olitorius* varietal trial at Gograghat, U.P was rejected as the crop was extremely poor,

Subvention trials in cultivators' plots.—During the year under report, 85 subvention trials were distributed to the five jute growing States as under :—

State	<i>capsularis</i>	<i>olitorius</i>	Total
West Bengal	10	20	30
Bihar	10	6	16
Assam	10	6	16
Orissa	9	4	13
U.P.	7	3	10
	—	—	—
Total	46	39	85

All the trials, except one *capsularis* trial at Supaul, district Saharsa, Bihar, were sown. Most of the trials were inspected in the field during the crop season and necessary particulars on the performance of the varieties were noted. 39 trials—20 *capsularis* and 19 *olitorius*—were successful and the rest failed to various reasons such as damages by flood, cattle, diseases and pests, poor growth due to unfavourable weather, lack of proper interculture, lack of proper supervision etc. Results of analysis of yield data from the successful trials are given in the table below :—

TABLE III

State	<i>Capsularis</i> or <i>Olitorius</i>	No. of successful trials.	Variety	Yield per acre (Md.).	Per cent on control
West			D154	20.82	104.62
Bengal.	<i>Capsularis</i>	4	JRC-1	20.42	102.61
			JRC-212	20.31	102.60
			Local	19.90	100.00
			JRC-13	18.97	95.33
			P —	Large	
			S.E. %	3.9	
	<i>Olitorius</i>	12	JRO-632	24.75	129.51
			JRO-753	24.20	126.64
			JRO-620	22.95	120.09
			C. G.	20.06	104.97
			Local	19.11	100.00
			P —	0.01	
			C. D.	2.54	
			S.S.%	3.2	
Bihar	<i>Capsularis</i>	5	JRC-1	25.12	117.55
			D154	23.79	111.32
			JRC-13	23.48	109.87
			JRC-212	22.87	107.02
			Local	21.37	100.00
			P —	0.05	
			C.D.—	2.27	
			S.E.%	3.27	

State	<i>Capsularis</i> or <i>Olitorius</i> .	No. of successful trials.	Variety	Yield per acre (Md.).	Per cent on control
Assam	<i>Olitorius</i>	1	Data inadequate for analysis.		
	<i>Capsularis</i>	2	—do—		
	<i>Olitorius</i>	3	JRO-632	21.15	116.66
			C. G.	19.86	109.54
			JRO-620	18.94	104.47
			JRO-753	18.52	102.15
			Local	18.13	100.00
			P —	Large	
			S.E. %	4.3	
Orissa	<i>Capsularis</i>	5	JRC-13	24.01	105.33
			JRC-212	23.41	102.72
			JRC-1	22.93	100.58
			Local	22.80	100.00
			D154	21.96	96.32
			P —	Large	
			S.E. %	3.7	
U.P.	<i>Olitorius</i>	1	Data inadequate for analysis.		
	<i>Capsularis</i>	4	JRC-1	26.20	129.51
			JRC-212	25.35	125.31
			D154	22.99	113.64
			JRC-13	22.24	109.94
			Local	20.20	100.00
			P —	0.01	
			C.D.	4.29	
Total	<i>Olitorius</i>	2	Data inadequate for analysis.		
	<i>Capsularis</i>	20	20 trials successful out of 45 trials sown.		
	<i>Olitorius</i>	19	19 trials successful out of 39 trials sown.		

It may be seen from the table above that among the *capsularis* strains, JRC-1 and JRC-212 proved significantly superior to the 'locals' in U.P. giving about 30 and 25 per cent

higher yield respectively. JRC-1 and D154 proved significantly superior to the 'locals' in Bihar yielding about 18 and 11 per cent higher respectively. There was no significant difference in yield between the varieties in the trials carried out in West Bengal and Orissa.

The *olitorius* improved strains, JRO-632, JRO-753 and JRO-620 proved significantly superior to the 'locals' in West Bengal yielding about 30, 27 and 20 per cent higher respectively.

Polyploidy—1950 colchicine treated series: (i) Capsularis.—Seeds of 15 single pods from 8 selections of *capsularis* poly-ploids representing two of the original lines, one full green and another green coppery red, were grown pod-wise during the year. As in the previous years, germination was very poor though sufficient plants were obtained to propagate the lines. The plants maintained the characteristics of poly-ploids. The average number of seeds per pod in *capsularis* poly-ploids was 16 but the number of good seeds was about 11. One of the selections—a full green plant—was sterile and bulk seeds and single pods were collected for further studies from 11 selected plants.

(ii) *Olitorius.*—9 selections of *olitorius* tetraploids covering the four original lines were sown during the year. To maintain the purity of lines, seeds of 23 single pods were sown. Germination of seeds of 22 of the pods was good and seeds from one of the pods failed to germinate. Though all the progenies were morphologically different from normal plants and majority of them exhibited the distinctive feature of tetraploids, 7.8 per cent of the progenies were dwarf plants with long leaves and irregular serrations differing from the rest. All these plants except one were completely sterile.

Seeds from 7 of the narrow leaved variants brought forward from the previous year, were sown. A large proportion of seeds failed to germinate and about 20 per cent of the

progenies gave plants similar in appearance to the parents and the rest were normal tetraploids. However, all these variants proved to be completely sterile.

Materials were collected from a number of normal and variant plants for cytological confirmation.

Single pod and single plant seeds from 30 selections of normal tetraploids and one selection of variant were collected for further studies.

Studies on the irradiation of jute with X-rays : X₃ generation.—17 *capsularis* and 8 *olitorius* selections of normal-looking plants from heterozygous families were grown. Besides, seeds from single pods of two weak, dwarf and late *olitorius* plants with short pods were also sown.

10 of the *capsularis* selections gave only normal plants and the rest segregated ; 4 of them segregated into plants having irregularly serrated wavy leaves and normal plants ; the rest gave sterile short-leaved mutants and normal plants. Plants showing wavy leaf character are fertile and are in the process of purification. The sterile mutation can only be maintained in stock by selecting and growing a sufficient number of normal plants.

The 8 *olitorius* selections grown proved to be normal. All the seeds from a single pod from one of the two *olitorius* dwarf plants gave narrow leaved, dwarf and stout plants with short internodes. All these plants were late in maturity, setting of pods occurring only in the fag end of the flowering season. None of the pods from these plants however, contained viable seeds.

A number of crosses with all the variants have been obtained using normal plants as mothers.

X₂ generation.—Selections from *capsularis* and *olitorius* materials, X-irradiated during the previous year were sown for further observation during the year under report. Of the 34

capsularis selections carried forward for morphological variations and variations in maturity, 31 proved to be normal. Two selections segregated giving plants with normal and small pods, and one gave branching and non-branching progenies. The non-branching progenies had dark leaves. 29 selections were made from plants showing morphological aberrations and better vigour.

10 *olitorius* selections from X-irradiated materials of the previous year were grown for further studies. 9 of them proved normal and 8 selections were made from plots showing some degree of variation, and vigour as compared to the normal.

A number of selections of *capsularis* and *olitorius* showing bifurcation of stem in the X_1 generation were grown in the X_2 and it was observed that the character was not heritable.

Vegetative rapprochement as a means of overcoming interspecific cross incompatibility in jute.—Seeds from both stocks and scions of two successful grafts made during the previous year were grown. 17 fresh grafts were attempted using the splice, cleft and inarch methods during the current year constituting the fifth generation. Seeds from both stocks and scions from 15 successful grafts were collected for further studies.

13 interspecific crosses between *capsularis* and *olitorius* were attempted among the grafted plants and though 11 of the crosses developed into mature pods ; none produced viable seeds.

Inheritance of Character

Genetic strains.—In all 88 selections brought forward from the true breeding cultures of the previous year were grown for confirmation and maintenance. The seeds of *C. depressus* failed to germinate. In all the other cultures, germination ranged from good to poor. The progenies of each culture

were studied and were observed to breed true to their respective parents. 480 selections were made from the different cultures for further studies.

75 selections brought forward from the purification series of the previous year, besides two materials from the bulk plots were also grown. The performance of the progenies of the different cultures in respect of the characters on the basis of which they were selected, was studied. 10 cultures, which bred true to their parents, were included in the pure series to be grown during the next season. 302 selections were made for further studies.

Isolation of full-green genotypes.—47 successful test crosses, made during the previous year for confirmation of the various full green genotypes, and 23 parents were sown. The progenies of crosses and parents were studied and 11 parents belonging to six full-green penotypes were confirmed and selected for inclusion in the genetic strains.

47 successful fresh crosses were obtained to confirm the known genotypes and for isolation of some of the remaining genotypes. The crosses and 27 parents were carried forward.

Capsularis leaf-variants : Deeply serrated, female-sterile type.—10 normal selections made in the plots which segregated for the variant character during the previous year were grown. 8 of the families were heterozygous and segregated giving normal and variant types, and the rest bred true. As the variant is a female-sterile type and can be maintained in stock only by crosses with normal plants or by growing a sufficient number of normal selections from the heterozygous families, 46 selections of normal plants were made from the segregating families for further studies.

Crumpled-leaf type : (i) Capsularis.—The crosses and parents carried forward from the previous year were grown. The leaves of the progenies of crosses between crumpled and normal types were more like that of the normal parent. Test

crosses showed that the green pigment of the crumpled leaf mutant is the full green type corresponding to the green copy-red type, that is, it is the same pigmentation genotype as the variety JRC-212, in a seed plot of which it was first detected. Seeds were obtained from 18 back crosses, six selfed F_1 plants and the parents for further studies.

(ii) *Olitorius*.—A light-red *olitorius* plant with crumpled leaves was observed in a plot of cultivator's types and transplanted in a pot for observation. It maintained the peculiar character of the leaves till the end. To study the inheritance of this character, the plant was crossed to dark-red and full green types of *olitorius* with normal leaves. Crosses and parents were carried forward for further studies.

Inheritance of leaf shape and size in C. capsularis.—9 selections of F_1 plants, 31 of the successful back crosses and 7 parents covering broad, normal and narrow leaf types of *capsularis* were grown. Germination ranged from good to fair. The F_2 and back-cross families segregated into the different phenotypes and a fixed number of leaves from all the plants including the parents were measured. The data are under study.

Inheritance of plant height.—17 of the successful back crosses, three F_1 selections and two parents of *capsularis* were sown during the year. Besides, eight back crosses, three F_1 selections, four fresh crosses and five parental selections of *olitorius* were also sown. The germination in the fresh crosses and parents was normal but in the back crosses and in the F_1 selections of both *capsularis* and *olitorius* was very poor. The F_1 selections in both the cases, were resown but even then the germination was poor. 23 back crosses covering all the combinations were obtained in *olitorius*. The parents, F_1 selections and back crosses were carried forward. Fresh crosses involving some combinations of *capsularis* were also made. The crosses and parents were carried forward.

Inheritance of earliness in C. capsularis.—The back crosses and F_1 selections of the crosses between Maniksari and D154

were grown along with their parents. 47 fresh crosses covering combination of early, medium and late types made during the previous year were also grown along with 31 selections of parents. The F_1 s were back crossed to their respective parents but only a few of the crosses were successful. The dates of flowering, pigmentation, plant height and base diameter of all the plants were recorded. In all, 385 selections were made in the families of F_1 s, F_2 s and the parents.

II. ANATOMY

1. Structure and Quality of Jute

A study was taken up to find out the relationship between the dimensions of ultimate fibres and the quality of jute. Yarns of *C. capsularis* and *C. olitorius* tested separately for their breaking strength at the Technological Research Laboratories were classified into high, medium and low. Five samples were taken for each class and macerated separately. One hundred ultimate fibres were measured for length data and twentyfive for breadth. These data have been statistically analysed and the results are given in Table IV.

TABLE IV
Dimensions of ultimate fibres in graded yarns.

Quality	C. Capsularis			C. Olitorius		
	Length μ	breadth μ	Length- breadth Ratio	Length μ	Breadth μ	Length- breadth Ratio
High ...	2487	22.3	111.44	2415	20.6	117.37
Medium ...	2317	24.4	94.94	2331	20.9	111.77
Low ...	2340	23.8	98.61	2195	22.2	99.09
P ...	0.01	0.01	0.01	0.05	0.05	0.01
C.D. ...	101	1.31	8.73	1.40	1.00	13.35

The above data indicate that in better quality yarns the ultimate fibres tend to be long and slender and that the length-breadth ratio is comparatively higher. This trend is noticed

in *C. olitorius* but it has not been observed between medium and low quality yarns of *C. capsularis*. The quality of jute is influenced by several factors of which the method of retting is the most important one. Even though the ultimate fibres are long and slender, the strength of the strand can be lowered by over-retting. This is more likely to happen in *C. capsularis* where there is an excessive development of periderm. Periderm is impervious to water and more resistant to retting action. This naturally leads to longer retting period which weakens the fibre strands. This appears to be the reason why in spite of long and slender fibres, the yarn gives different performance in *C. capsularis*.

2. The Effect of Fertilizers on the Formation and Structure of Fibres

A study has been taken up to investigate the effects of ammonium sulphate, compost and superphosphate on fibre development. The plants were collected in 3 stages of harvest from a trial conducted by the Chemistry Section. Five plants were taken at a time for each treatment, thus altogether 15 plants were studied from each manurial treatment. The number of fibre bundles in a fibre wedge, the number of fibre bundles in the first layer near the cambium, the total number of fibre bundles in the entire section and the number of layers were counted. The number of ultimate fibres in a cross-section of fibre bundle and the dimensions of ultimate fibres will be measured next year.

There is an indication that, with the application of nitrogen from ammonium sulphate or from compost the number of fibre bundles in a fibre wedge decreases. Although there is a marked increase in base diameter and height of the plants, the number of layers remained either constant or sometimes even decreased. In spite of this, the total number of fibre bundles increased. This increase is a result of an increase in the number of fibre wedges due to an increase in the base diameter of the plant as already reported.

With the application of superphosphate the number of fibre bundles in a fibre wedge increased. The number of

layers was more even without significant increase in base diameter and height of the plants in contrast to ammonium sulphate or compost treatments. The total number of fibre bundles did not increase because of absence of any increase in the base diameter of the plant.

Nitrogen, either from ammonium sulphate or from compost evidently increased the number of fibre bundles in the first layer but each fibre wedge contained fewer fibre bundles. Phosphate, on the other hand, increased the number of fibres in a fibre wedge by increasing the number of layers although there was no effect on the total fibre content of the plant.

Further work is in progress.

III. CYTOGENETICS.

1. Interspecific Hybridization

To study the intra—and interspecific relationship between the cultivated and the wild species of *Corchorus*, and to find out the possibility of producing amphidiploids, interspecific hybridization involving the different species and varieties including some autotetraploids of cultivated and wild types was carried out. In all the crosses, the number of flowers pollinated, pods set and pods harvested were recorded. The seeds were collected pod-wise and they were classified into full, partially full and empty (shrivelled). The weight of full seeds obtained from crosses was compared with that of selfed seeds of parents.

Setting of pods was noticed in most of the combinations though the percentage of setting varied from 0 to 100. About 60 per cent of the pods set, shed in course of development and seeds were obtained from the rest except in one case where the pod was empty. The weight of full seeds from crosses was, in general, lower than that of normal seeds. 578 crosses were made between the diploids of the cultivated species in 24 different combinations and 96 mature pods were obtained. Pods could not be obtained from 4 of the combinations and

full seeds varying from 5.05 to 40.6 per cent were obtained from 10 of the combinations. This indicates that fertilization occurs at least in some of the crosses. In 10 other combinations pods with half-full or empty seeds were obtained.

62 crosses covering 4 different combinations were made between the wild types of *C. olitorius* and *C. capsularis* at diploid level. There was no setting of pods in one of the combinations and the other combinations produced one mature pod in each case. However, only a single combination, between a wild *capsularis* type from Bombay and a wild light red pigmented *olitorius* type, produced full seeds.

132 crosses were made covering 5 different combinations of wild and cultivated types of *C. olitorius* and *C. capsularis* at diploid level and 23 mature pods were obtained, the maximum number (13) of mature pods being from the combination—wild *olitorius* green $\times$ D154 and the maximum number of full seeds being from the combination—wild *olitorius* light red $\times$ D154. Three of the 5 combinations including wild *olitorius* green $\times$ D154 produced practically empty seeds and full seeds were obtained only from the other two.

Of the 216 crosses made in 12 combinations between the autotetraploids of wild and cultivated types of *C. capsularis* and *C. olitorius* and also their diploids, only 15 pods were harvested from 6 of the combinations. The number of pods harvested varied from 1 to 6 in these combinations. No setting was obtained in reciprocal crosses between the autotetraploids of the cultivated types but crosses were slightly more successful when autotetraploids of wild types were used.

Crosses were made between the wild species of *Corchorus*, *C. aestuans* (= *C. acutangulus*), *C. trilocularis*, *C. tridens* and *C. siliquosus* and wild *C. capsularis* and wild *C. olitorius*. Crossed pods could be obtained only from the combinations—wild *C. olitorius* L. R. $\times$ *C. aestuans*, Bombay wild *C. capsularis* $\times$ *C. aestuans*, Bombay wild *C. capsularis* $\times$ *C. trilocularis*, and *C. trilocularis* $\times$ Bombay wild *C. capsularis*, but full seeds were not obtained in any one of them except the last.

The full seeds from 10 interspecific crosses obtained during the previous year were sown. Seeds from 8 of them germinated and the progenies in 7 crosses resembled the female parent. The eighth, from the combination JRO-632 $\times$ Maniksari, gave plants which resembled JRO-632 in most respects except the pigmentation of stem, petiole and veins of leaves which was light-red; pollen grains from three random selections were tested with acetocarmine and about 95 per cent of them stained thus suggesting high viability.

Study of factors involved in incompatibility between C. capsularis and C. olitorius in crosses.—Pollen tubes in sections of pollinated pistils were found to stain well when stained according to Foster's tannic acid-iron chloride schedule with Resorcin blue. This method will be used in future for studies on pollen tube growth in pistils of interspecific crosses.

2. Cytological Studies

Cytological investigations of certain individuals of $2n \times 4n$ population of C. olitorius (var. C.G.)—103 p.m.c.s. were analysed and 46.4 per cent of them showed irregularities as laggards (23.2 per cent), chromosome bodies lying in cytoplasm (20.3 per cent) and bridge-fragment association (2.9 per cent). Sometimes the laggards were seen dividing during anaphase I; those which failed to reach the poles either formed micronuclei or disappeared in the cytoplasm. The distribution of chromosomes to the two poles was very irregular. The percentage of univalents at metaphase II was only 38.6 per cent as compared to 61.2 per cent during metaphase I. The chromosomal bodies lying in cytoplasm was 34.4 per cent in the second division. Occasionally the presence of three spindles was also noticed.

During diakinesis the mean number of chromosome association per p.m.c. is as follows:—hexavalents 0.12, quadrivalents 1.9, trivalents 0.35, bivalents 5.0, univalents 2.0 and fragments 0.12.

Sporad analysis of tetrads revealed large variations in the number and size of microspores and micronuclei. In order of the frequency of their occurrence tetrads, triads, pentads, hexads, diads, octads, monads and heptads were prevalent among the sporads. Though about 80 per cent of the tetrads were normal looking, the size of microspores varied. The occurrence of monads indicates the formation of restitution nuclei in the first division and its failure to divide in the second division of meiosis. The number of micronuclei varied from 0 to 5 ; in a single instance 8 were noticed.

3. Colchicine Treatment and X-irradiation of Jute

(i) *Colchicine treatment of wild types of C. capsularis and C. olitorius.*—The seeds were treated with different concentrations—0.25 per cent 0.05 per cent 0.1 per cent and 0.2 per cent—of aqueous solution of colchicine for 6, 12, 24 and 48 hours and were sown in pots. The seedlings that were found to be affected were transplanted in the field.

The analysis of pollen grains of twenty-two affected plants of the wild type of *C. capsularis* indicated that four of these plants were polyploids. The size of the grains varied much (range of length $30.4\ \mu$ to $67.2\ \mu$, and range of breadth $19.2\ \mu$ to $57.6\ \mu$). The percentage of stained grains were above 20.

The seeds of 14 affected plants of the wild type of *C. olitorius* collected last year were sown. Pollen grains analysis indicated polyploid plants in the population of three of them. The flower buds and root tips of these polyploid plants were fixed for cytological analysis. Preliminary studies of meiosis showed that they were autotetraploids ($2n = 28$). They were utilized in interspecific hybridization programme.

(ii) *Induction of mutations by the use of X-irradiated pollen.*—The method followed for irradiation and pollination was the same as reported last year. As the lethal dose could not be reached last year, the dosages were increased to 600, 800, 1000, 1200 and 1500 r units. The results are summarised in table V.

TABLE V.

No.	Cross		Average r units	No. of flowers polli- nated.	No. of capsules set.	Number of seeds.			Total	Percen- tage of full seeds.
	Parent	Parent				Empty	Partially full	Full		
1.	JRO-632	JRO-632 (352)	600r	14	6	289 (295)	189 (255)	185 (400)	663	27.9
2.	JRO-632	JRO-632 (322)	800r	12	6	31	6	330	367	39.9
3.	JRO-632	JRO-632 (350)	1000r	12	8	108 (35)	77 (97)	449 (970)	634	70.8
4.	JRO-632	JRO-632 (495)	1200r	17	11	263 (180)	65 (74)	269 (454)	597	45.1
5.	JRC-212 (114)	JRO-632 (262)	1500r	16	7	109 (55)	76 (87)	145 (237)	330	43.9
6.	JRC-212 (114)	JRC-212	600r	12	9	69 (104)	48 (109)	41 (105)	158	2
7.	JRC-212 (97)	JRC-212	800r	14	10	57 (105)	69 (54)	37 (95)	163	22.7
8.	JRC-212 (134)	JRC-212	1200r	20	25	124 (170)	56 (147)	45 (124)	225	20.6
9.	JRC-212	JRC-212	1200r	15	10	nil	nil	nil	nil	nil
10.	JRC-212 (103)	JRC-212	1500r	20	12	34 (47)	30 (64)	38 (102)	102	29.4

(Figures within brackets are weight of seeds in mgms. The number of seeds of the parents correspond in number to the full seeds from the cross.)

Interspecific crosses between JRO-632 and JRC-212 were made in both directions using pollen irradiated with 5 different doses of X-rays ranging from 600 to 1500r units. The setting of pods was fair in all the crosses except when JRO-632 pollen treated with 1000r was used. However, all the pods obtained, contained only empty seeds.

No mutation was found in the progenies raised from the 1953-54 experiments ; however, some plants were selected for morphological and cytological studies. The seeds of selected plants of JRO-632 and JRC-212 have been carried forward.

(iii) *Cytological studies of X-ray induced mutations in jute —C. olitorius.*—Seeds of 8 selected X_1 plants showing some morphological aberrations including bifurcation of stem, were sown. Besides, seeds of an untreated plant showing bifurcation of stem, were also grown. One of them failed to germinate and all the rest except one showing narrow crinkled leaves produced only normal-looking individuals. About 10 per cent of the progenies of this plant differed from the normal plants ; these had drooping leaves, succulent and angular stems, particularly at the top and flowered about 10 days earlier.

Cytological studies were made with flower buds fixed during the previous year from three X_1 plants which showed some morphological peculiarities. In the untreated material usually 7 II are observed. But in the irradiated individuals studied, 7 II + 0 to 2 fragments, 1 IV + 5 II + 0 to 3 fragments or 2 IV + 3 II + 0 to 3 fragments were observed. The fragments differ in size from small to large dots and short to long rods. Frequently a pair of small dot-shaped fragments having a membrane around was found in the cytoplasm and rarely on the spindle. Sometimes three fragments were noticed in a group. Though varying number of fragments are found, they probably get lost in the cytoplasm, instead of ending up as micronuclei as only one metaphase plate revealed the presence of a micronucleus. Occasionally one or two bivalents fail to separate at anaphase leaving one of the nuclei deficient ; such deficient

nuclei generally fail to function. Various combinations of brodge-fragment association were observed at snaphase I. In a few cases single chromosome bodies with a membrane around were observed in the cytoplasm.

Fragments were also common in the second meiotic division. Though rarely, abnormal spindle and bridge fragment associations were seen in anaphase II.

Sporads analysis of all the eight aberrant plants was carried out and it was observed that variations in the number of spores in the sporads ranged from nonad to heptad though, as expected, tetrads are most common and triads came next. There is a large variation in the size of the pollen grains and the percentage of pollen fertility varies from 77 to 97.

4. Pollen Grain Studies

Comparative studies on the rates of the pollen tube growth of the two cultivated species of jute in vitro—Freshly collected pollen grains of C.G. (*C. olitorius*) and D154 (*C. capsularis*) were grown on slides coated with sugar-agar-gelation medium and the length of pollen tubes was measured at intervals of 30 minutes. The measurements were made upto 90 minutes of placing the slides with pollen in the moist chamber as, by that time, the pollen tubes practically ceased to grow. 25 observations were made in each case and studies were made on alternate days for 6 different dates. In general, the initial growth—at the end of the first 30 minutes is found to be more in C.G. than in D154. Except in a single instance the maximum length of the pollen tube recorded at the end of 90 minutes is more in C.G.

IV. PHYSIOLOGICAL INVESTIGATIONS

1. Investigations on the physiology of jute seeds

(i) *Viability efficiency of seeds collected at different stages of maturity from green capsules, half-matured capsules and fully-matured.*—The experiments have been continued with *capsularis*

varieties—D154, Fanduk and JRC-212, and *olitorius* varieties—C.G., JRO-632 and JRO-753. The results of this year also showed the same trend as that of previous years with minor variations.

(ii) *Investigations on the dual-purpose of harvesting jute.*—

Field experiments were continued this year to test the practical application of 'dual purpose' of harvesting. The varieties taken were D154, Fanduk, JRC-212 of *capsularis* and C.G., JRO-632, JRO-753 of *olitorius*. Pods were harvested at four different stages of maturity. The dates of harvesting of different varieties were different this year whereas last year all the varieties were harvested at the same time. All the plants from each harvest were divided into two sets—in one, whole plants were retted for fibre yield and in the other, top portions of plants, upto 6" below the point of bifurcation were removed for collection of seeds and the rest was retted for fibre. Thus for each harvest the comparative yield of fibre from the whole stem, and from stems whose top portions were removed for seeds, and the corresponding yield of seed and the viability percentage of seeds were obtained. As in previous years, it was found that by removing the top portions for seed, the yield of fibre is slightly reduced, but in return, a good quantity of seeds is obtained.

(iii) *Performance of jute seeds collected from plants grown in off season (winter).*—The experiments were repeated this year with D154, JRC-212 (*capsularis*) and C.G. and JRO-632 (*olitorius*). Seeds were collected from plants grown during last winter (November-January). The plants raised from these seeds showed normal performance in growth, height and basal diameter as compared to plants from seeds produced in normal season. No appreciable difference was noticed in flowering habits and fruit-setting.

2. Nature and range of flowering and seed formation in different varieties of jute

Investigations have been in progress for the last four years. Almost all the important varieties of jute, viz., Fanduk, Jap

Red. JRC-212 (*capsularis*) and C.G., R-26, JRO-632, JRO-620, JRO-753 (*olitorius*) have been studied. They were sown on the same date and the rate of flowering was recorded each day throughout the flowering period beginning from the first day of flowering in each of the varieties. The results obtained this year showed that all the varieties within the same species have almost identical nature of flowering period, rate of flowering and distribution of flush of flowering over the flowering range. Thus after the initiation of flowering, the nature of flowering curve was similar in both early and late varieties.

(ii) *Performance of seeds formed at different times of flowering period.*—The formation of capsules and the setting of seeds in them at different stages of flowering period has already been reported. During the year the plants raised from these seeds were studied. It was difficult to sow all the seeds which were collected daily. So a workable plan was drawn up grouping the seeds week-wise in accordance with their origin on the flowering curve. Forty-six such groups were made according to the variety and the period of active flowering. They were sown in replicated plots in lines and equal spacings were given from row to row as well as from plant to plant in the same line. The plants were numbered and periodical observations were made on the following :—

Growth performance.—The progenies raised from pods collected from different weeks of flowering period did not show significant difference in growth and height and basal diameter. When the population was divided into different height groups, it was found that the groups were represented evenly in all the weeks irrespective of the sequence of collection from different weeks in the flowering range.

Stripped weight method for fibre yield.—Bark measuring six inches in length was peeled off at a height of one foot from the ground to find out the content of fibre. The calculated yield of progenies varied irrespective of the origin of seeds on the flowering curve.

Trend of flowering.—The flowering habit of the progenies showed trend similar to that of the mother plant. The specific trends of the flowering curves as found in *capsularis* and *olitorius* species were shown in the progenies of seeds collected at different points on the flowering curve. This is an important conclusion showing that seeds formed in the early, middle or late stages of the flowering period maintain the same characteristic of the flowering habit. Selfed seeds were collected for studies.

3. Effect of vernalization and photoperiods on the phasic development of jute plants

Experiments to find out the degree of response to temperature and different photoperiods were continued with D154, Fanduk and JRC-212 (*capsularis*) and C.G., JRO-632 and JRO-753 (*olitorius*) to find out the degree of response to different temperatures and photoperiods.

Pre-sowing cold treatment alone brought about an earliness of 15-18 days in flowering in *capsularis* varieties, while a lateness of about 8 days was noticed in *olitorius* varieties. The effect of presowing cold treatment on the vegetative growth was found to be the same on both the species, *i.e.* delayed germination and stouter seedlings with leaves more dark-green than the controls. But this difference of green colour of the leaves disappeared after three weeks.

During this year additional data were obtained on variation in the rate of vegetative growth, first bud-formation and the range and period of flowering, as a result of photoperiodic treatments.

Both *capsularis* and *olitorius* varieties show great response to variations in day lengths. Responses to 16 hours light period alternating with 8 hours dark period and to short-day lengths of 8 hours light period alternating with 16 hours dark period were investigated. The different varieties showed differential

response depending upon the age of the plant when the different photoperiodic treatments were begun. In general, a greater earliness in flowering was obtained when short photoperiods were given in the early seedling stage. It was observed that the photoperiodic treatment brought about a shortening of the flowering range with consequent decrease in the flush of flowering. The effect of long photoperiod invariably delays the initiation of first flowering by about a week.

4. Experiments on salt-resistance in jute

The field experiment in the saline regions of West Bengal could not be conducted due to drought in the early part of the season in Kakdwip area, where our experimental plots were selected. Unless irrigation facilities are available it may be difficult to conduct such experiments in saline areas. The following experiments, however, were conducted at Nilganj under farm and laboratory conditions.

(i) *Inducing resistance by pre-sowing treatment with different salt concentrations.*—Seeds were soaked in 0.5 per cent, 1.0 per cent and 1.5 per cent NaCl for 12 hours, 24 hours, 48 hours and 72 hours, and tested for salt-resistance against controls which were soaked only with water. Slight salt-tolerance was developed in plants raised from treated seeds.

(ii) *Inducing resistance in seedlings by growing them in critical salt concentration and collecting seeds for further experimentation.*—Some seeds were collected from seedlings grown in the last season in a concentration of 1 to 1.5 per cent NaCl solution. The seeds were tested for salt resistance, but no definite result was obtained. The experiment will be continued.

(iii) *Treatment of seeds of wild types.*—The wild species *C. siliquosus*, *C. tridens* and *C. trilocularis* were tested for salt-resistance in 0.5 per cent, 1.5 per cent and 2 per cent NaCl solution. The seeds were found to be more resistant

to salt concentration than the cultivated ones. The wild seeds germinated very slowly and tolerated a higher concentration (2.0 per cent) of NaCl where a good germination rate was shown as compared to cultivated types which could not tolerate a concentration higher than 1.5 per cent NaCl.

(iv) *Effect of different salt concentrations on the water-relation in jute plants.*—Plants were raised in water culture solution providing all the essential nutrients, to which different concentration of NaCl were added and the rate of transpiration and absorption of water was measured at 3 hours intervals. It was found that rate of transpiration was very much depressed in higher salt concentration, as compared to the control, the diurnal variation in transpiration rate, however remained the same. The transpiration rate was more suppressed in the *olitorius* variety C.G. than in the *capsularis* variety D154 under identical concentrations.

5. Variations in growth and pattern of unit structures contributing towards the yield of fibre

Results on the variations in growth of such structures as, phloem pyramids, distribution of fibre bundles in the pyramids and formation of layers of fibre bundles per pyramid during the life-cycle of the plant have already been reported in case of D154, Jap Red (*capsularis*), C.G. and JRO-620 (*olitorius*). Further results obtained indicate that the rate of layering was different in different varieties, which corresponded with the period of active vegetative growth.

6. Investigations on the moisture content, bark and fibre growth and wood formation during the life-cycle of the plant

Results obtained during the last five years have been analysed under the following categories :—

- (a) variations in moisture content and the relation of moisture content to the dry matter produced,

- (b) variations in the growth of bark and pure fibre at different heights of the stem and at different stages of the plant growth ,
- (c) distribution of pure fibre along with the length of the growing stem,
- (d) variations in the formation of wood and its relation to the bark formation and,
- (e) variations in growth and pattern of unt structures contributing towards the yield of fibre.

The results which have given sufficient indication on the inherent nature of growth of the different varieties and their distinctive features from each other may be utilised in our scheme of breeding of improved varieties.

Based on these results a new method of estimating fibre content by stripped bark weight was taken up. The method consists of taking out a small sample of bark from a fixed area of 1 cm × 15 cm. This is done by placing a small piece of a half-tubular galvanized sheet with a slit of 1 cm. × 15 cm. adjusted to fix it on the stem of the plant to facilitate cutting of the bark. This is placed on the stem at the required height and pressed with the hand and then with a sharp pointed scalpel the bark is scooped out of the slit. By this method a definite area of bark can be scooped out easily from a large number of plants within a short time. The pieces of scooped bark can be dried and weighed. Studies are being continued to correlate the dry bark weight with the height and basal diameter of the same plant for facilitating the selection of promising plants from standing crops without waiting for the harvesting and retting of the plants.

(ii) *Percentage variation in the distribution of pure fibre.*—Analysis of the results obtained indicated the same trend of variations as was reported previously, viz., more fibre was found in the bottom portion in *capsularis* than in *olitorius*

varieties. With the progressive lengthening of the stem, the fibre distribution becomes more uniform in *olitorius* than in *capsularis* varieties.

(iii) *Ratio of bark formation to that of wood formation.*—The data obtained during previous years were analysed. The results show a higher ratio of bark formation to that of wood formation in JRO-620 than in C.G.

7. Linear growth of internodes and their distribution along the stem

Along with the study of variation in the different growth components, the rate of growth in length of different internodes beginning from the cotyledonary node, at different stages of plant growth was undertaken in D154, Fanduk (*capsularis*) and C.G. and R-26 (*olitorius*). The measurements were made at 43 days, 57 days, 71 days, 85 days, 99 days and 113 days from the time of sowing. The growth in length of each internode, the distribution of internodal length along the stem were recorded. A large number of measurements were made which showed that internodal lengths varied and there was no regular sequences in the increase in length from the cotyledonary node upwards. But taking the stem as a whole it may be said that internodes of maximum lengths (2.0" in Fanduk, 2.4" in D154, 2.8" in R-26 and 2.8" in C.G.) were laid from about 7th internode to 40th internode in case of *olitorius* varieties and from 12th internode to 30th internode in case of *capsularis* varieties. It was therefore seen that longer internodes were found in *olitorius* varieties than in *capsularis* varieties.

8. Growth sequence in relation to stalk and foliage

The experiment was repeated for the second year, and the results were obtained from N.P.K. trial conducted by the Agronomy Section, on D154 (*capsularis*) and JRO-632 (*olitorius*). The samples were taken at intervals of 49 days, 68 days, 88 days and 111 days from the time of sowing. The weight of the stalks together with the leaves was first estimated and then the stripped weight was estimated after removing all

the leaves. The samples were taken from all the 12 combinations of N.P.K. including the control. Three plants from each of the six replications, that is, 18 plants for each combination were collected. With higher doses of nitrogen and potassium more leaves were formed but it was depressed if K were less or absent. Highest output of leaves was found in $N_1P_1K_1$ and $N_2P_1K_1$ in case of D154. The same was found in JRO-632 but the leaf fall was more in JRO-632 than in D154. The percentage stalk growth was found to be more in higher doses of nitrogen as was expected. At 49 days growth 30 per cent of total green matter accounted for foliage and 70 per cent for stalk in both D154 and JRO-632 but in later stages of 111 days growth 22 per cent was recorded for foliage and 78 per cent for stalk in D154, while 15 per cent for foliage and 85 per cent for stalk in JRO-632.

9. Sand culture experiments at different nutritional levels

Preliminary experiments were conducted in glazed earthenware pots in sand culture. Different nutritional solutions were tried to find out in which solution the jute plant grows well. It has been possible to grow quite normal jute plants in sand culture by often changing the solution and keeping the cultures in aseptic conditions. The plants were also grown in different cultural media with deficient nitrogen, phosphorus and potassium. The rate of vegetative growth, leaf output and initiation of flowering were recorded. The experiments would be repeated again.

V. JUTE AGRONOMY

1. Variety-cum spacing-cum manuring on Jute

To study the effect of various spacings and manures on early and late jute varieties, two trials, one with *capsularis* and another with *olitorius* were repeated during the year under report. Two varieties, viz., Fanduk (early) and D154 (late) were included in the *capsularis* trial, while C.G. (early) and JRO-632 (late) in the *olitorius* trial. The spacings tried were

light thinning $\times 12''$, $2'' \times 12''$ and $3'' \times 12''$ as against the usual broadcast sowing. Line sowing was done by drill and the spacings between plants were adjusted later. Manures applied were at two levels, viz., 0 lb. N and 40 lb. N per acre, both from organic and inorganic sources at equal N basis. Compost as organic manure was applied at 50 per cent N availability basis at the time of sowing and ammonium sulphate as inorganic fertilizer as a top-dressing.

Germination in the case of *olitorius* was gappy. Moreover, a drought in the very early stage was responsible for the death of a large number of seedlings. Consequently the trial was resown in June. A long spell of drought again in the later part of July affected the crop by causing considerable wilting of plants, particularly in *capsularis*. Further the growth of the standing plants was very much stunted and they were damaged to some extent by semilooper. The analysis of the data of both the experiments revealed that the combined treatment effect was significant at 1 per cent level. The late varieties of both *capsularis* (D154) and *olitorius* (JRO-632) with the treatment light thinning $\times 12''$ and 40 lb. N gave the highest yields of 28.19 maunds and 25.45 maunds per acre respectively as against 18.53 maunds and 18.09 maunds of the same varieties used as controls (No manure—Broadcast). The per cent increase in yield due to the application of manures was more in the early varieties than in the late varieties.

(i) *Effect of nitrogen, phosphorus and potash.*—To study the effect of different doses of nitrogen, phosphorus and potash and also of their combinations on the yield and quality of fibre, two trials, one with *capsularis* and another with *olitorius* were carried out. The treatments in either trial included 3 levels of nitrogen (0 lb., 20 lb. and 40 lb. N per acre), 2 levels of phosphorus (0 lb. and 40 lb. P_2O_5 per acre), 2 levels of potash (0 lb. and 25 lb. K_2O per acre) and the combinations thereof. The data on the yield of *capsularis* are given in Table VI

TABLE VI

Manurial trial—Capsularis (D154)

Layout—Replicated randomized blocks in 4 replications.

Effective plot size—18' × 32' or 0.0132 acre.

Sown on 26-5-54. Harvested on 2-10-54.

Treatment	Fibre yield per acre (Md)	Per cent on control	Extra yield due to fertilizer application (Md.
A. $N_0P_0K_0$	18.85	100.00	
B. $N_0P_0K_1$	20.20	107.16	1.35
C. $N_0P_1K_0$	20.06	106.42	1.21
D. $N_0P_1K_1$	20.00	106.10	1.15
E. $N_1P_0K_0$	22.70	120.42	3.85
F. $N_1P_0K_1$	19.86	105.36	1.01
G. $N_1P_1K_0$	21.46	113.85	2.61
H. $N_0P_1K_0$	23.55	124.93	4.70
I. $N_2P_0K_0$	25.62	135.92	6.77
J. $N_2P_0K_1$	28.85	153.05	10.00
K. $N_2P_1K_0$	24.39	129.39	5.54
L. $N_2P_1K_1$	25.94	137.61	7.09
P	0.01		
S.E. %	5.67		
C.D.	4.85		

N_0 —0 lb. N ; N_1 —20 lb. N ; N_2 —40 lb. N.

P_0 —0 lb. P_2O_5 ; P_1 —40 lb. P_2O_5 .

K_0 —0 lb. K_2O ; K_1 —25 lb. K_2O .

In the *C. capsularis* trial, there was a significant increase in the yield of fibre with 40 lb. N in combination with P and K singly or together over the control (No manure). 40 lb. N together with 25 lb. K_2O (potash) gave an increased yield of 53 per cent over the control. This confirms the results of the previous year. Responses to nitrogen were not so very marked in *olitorius*.

(ii) *Effect of organic and inorganic nitrogen.*—To study the effect of nitrogen from organic and inorganic sources on yield and quality of jute, two trials, one with *capsularis* and another with *olitorius* were carried out. For inorganic source ammonium sulphate and for organic source a mixture (giving equal quantities of nitrogen) of town compost and sludge at 50 per cent N availability basis was used. The varieties in the trial were D154 for *capsularis* and JRO-632 for *olitorius*. The treatments included the application of 30 lb. available N per acre from both organic and inorganic sources and the control (No manure). The different proportions of nitrogen from both the sources were as follows:—

- (1) 100 per cent alone from inorganic source ;
- (2) 100 per cent alone from organic source ;
- (3) 67 per cent from inorganic sources plus 33 per cent from organic sources ;
- (4) 50 per cent from inorganic sources plus 50 per cent from organic sources ;
- (5) 33 per cent from inorganic sources plus 67 per cent from organic sources ;
- (6) Control (No manure).

Due to continuous rains shortly after sowing timely inter-cultural operations could not be given. This resulted in a poor and stunted crop. Moreover, long drought in the later part of July affected the crop considerably which remained very poor throughout. As the *capsularis* plants were very badly affected, the trial was discarded. In the *olitorius* trial, the treatment N 100 per cent from ammonium sulphate (inorganic) gave the highest yield of fibre, though the difference amongst the treatments were not significant.

(iii) *Application of fertilizers in instalments.*—To find out the effect of time of application of ammonium sulphate on the yield of fibre, two trials, one with *capsularis* and another with

olitorius, were laid out. The treatments included the application of 30 lb. N per acre in the form of ammonium sulphate at various stages of the growth of the crop (*i.e.* before sowing, at first weeding and at second weeding) either in one dose or in instalments. Due to continuous rains shortly after sowing, followed by a long spell of drought towards the later part of July, the crop was adversely affected. The results were found to be insignificant in both the trials.

(iv) *Comparative merits of various nitrogenous fertilizers on capsularis and olitorius jute.*—To study the comparative merits of various nitrogenous fertilizers on the yield and quality of jute, a trial was laid out including both *capsularis* and *olitorius*. The fertilizers used were ammonium sulphate, sodium nitrate, potassium nitrate, urea, ammonium sulphate nitrate, Chilean nitrate, Paul's mixture, Talukdar's mixture and control (No manure). The application of fertilizers was on the basis of 30 lb. nitrogen per acre. The varieties used were JRC-212 for *capsularis* and JRO-632 for *olitorius*. Half the quantity of each fertilizer was applied at the time of sowing and the rest as top-dressing when the crop was 40 days old. Statistical analysis of data revealed that the effects due to fertilizers were highly significant indicating that nitrogen from different sources behaves differently. The highest yield of 30.11 maunds per acre in *capsularis* and 29.27 maunds in *olitorius* was obtained by the application of ammonium sulphate, although it was in the same group with potassium nitrate, sodium nitrate, Paul's mixture and Talukdar's mixture. Ammonium sulphate proved to be significantly superior to Chilean nitrate, urea, ammonium sulphate nitrate and control (No manure). The percentage increase in yield was 17 to 21 over the control. The varietal effect and the effect due to interaction (fertilizer and variety) were not significant.

(v) *Comparative merits of organic manures against ammonium sulphate.*—With a view to study the effect of various organic manures as against ammonium sulphate on the yield and quality of jute, two trials, one with *capsularis* and

the other with *olitorius*, were conducted. The manures used were compost, sludge, F.Y.M., mustard cake and ammonium sulphate. The dosages tried included 5 levels of nitrogen viz., 0 lb., 20 lb., 40 lb., 60 lb. and 80 lb. per acre. The varieties used were JRC-212 for *capsularis* and JRO-632 for *olitorius*. Application of organic manures was done at 50 per cent N availability basis. Organic manures were applied at the time of sowing whereas ammonium sulphate was used as top-dressing to 35 days old crop. In this trial also the crop, particularly *olitorius*, was affected to a great extent by the prolonged drought some time in July. In the *capsularis* trial the treatment effects were found to be significant. Mustard cake, compost and ammonium sulphate at higher levels (i.e., 60 lb. N and 80 lb. N) gave higher yields than the others at 5 per cent level of significance. In the case of *olitorius*, which was sown somewhat late, the crop was adversely affected since timely interculture could not be given. This resulted in poor and stunted plants. The analysis of the data did not reveal significant treatment difference. This was perhaps due to the soil being considerably heterogeneous and poor.

3. Manurial trials in states

To ascertain and demonstrate the manurial behaviour under varying soil and climatic conditions and to make the cultivators manure minded, simple trials under cultivators' field conditions were conducted in the various jute growing states of West Bengal, Bihar, Assam, Orissa and U.P. The trials were modified on the basis of the trends obtained from the results of the last three years.

The trials were conducted in both acid and non-acid zones. The treatments of each were as follows :—

A. For non-acid zone

1. No manure(control).
2. 20 lb. N per acre.
3. 30 lb. N per acre.

4. 30 lb. N per acre + 40 lb. K_2O per acre.
5. 30 lb. N per acre + 30 lb. P_2O_5 per acre.
6. 30 lb. N per acre + 40 lb. K_2O + 30 lb. P_2O_5 per acre.

B. *For acid zone*

1. No manure (control).
2. 20 lb. N per acre.
3. 3 maunds lime alone per acre
4. 6 maunds lime alone per acre.
5. 3 maunds lime + 20 lb. N per acre.
6. 6 maunds lime + 20 lb. N per acre.

(The fertilizers used in the trials were ammonium sulphate for nitrogen, muriate of potash for K_2O and single superphosphate for P_2O_5).

The table below gives the list of trials conducted during the year under report.

States	Trials scheduled			Trials successful			Total number of trials failed or not conducted.
	Acid zone	Non-acid zone	Total	Acid zone	Non-acid zone	Total	
1. Bihar ...	18	84	102	2	9	11	91
2. West Bengal ...	...	30	30	...	...	...	30
3. Assam ...	...	16	16	...	12	12	4
4. Orissa ...	...	12	12	...	8	8	4
5. U. P. ...	...	6	6	...	3	3	3
Total	18	148	166	2	32	34	132

Bihar.—Originally 102 trials were scheduled for the state, 18 for acid zone and 84 for non-acid zone. Due to shortage of seeds of improved varieties, the number of trials had to be cut down. Seeds sufficient for only 20 trials could be supplied from Jute Agricultural Research Institute, Barrackpore.

However, only 14 trials were sown, of which 9 were successful in non-acid zone and 2 in acid zone. On an average, 30 lb. N together with 30 lb. P_2O_5 and 40 lb. K_2O per acre gave the highest yield of 16.01 maunds of fibre as against 7.27 maunds of the control. Application of 30 lb. N together with 30 lb. P_2O_5 or with 40 lb. K_2O also increased the yield of fibre appreciably.

West Bengal.—No trials were conducted during the year under report. The Jute Development staff expressed their inability as they were engaged with excavation and development work on the recommendation of the Quality Committee.

Assam.—Out of 16 trials originally scheduled, 12 were successful. Higher dose of nitrogen (30 lb. N) together with 40 lb. K_2O alone or in combination with 30 lb. P_2O_5 increased the yield of fibre considerably. Effect of nitrogen alone either at 20 lb. N or 30 lb. N was not so very prominent.

Orissa.—12 trials were conducted as scheduled of which 4 trials failed. Application of higher doses of nitrogen alone or in combination with potash or phosphate or both gave equally good results as that of the lower dose (20 lb. N) nitrogen. On an average, increase recorded was 50 per cent over the control.

U.P.—Out of 6 trials scheduled, 3 trials were successfully conducted. Application of 20 lb. N was as effective as 30 lb. N either alone or in combination with phosphate or potash or both.

4. Date of sowing experiments with *C. capsularis* and *C. olitorius*

To study (a) the effect of different dates of sowing on yield and quality of fibre and (b) the behaviour of different varieties when sown on different dates under Nilganj conditions, two trials were laid out, one with *capsularis* and the other with *olitorius*. This is the second year of the experiments.

The treatments included six dates of sowing at intervals of 20 days, beginning from the 16th March. Last sowing was

done on the 24th June. Fanduk (early) and D154 (late) in case of *capsularis* trial and C.G. ((early) and the JRO-632 (late) in the case of *olitorius* were included. For want of rain first two sowings, i.e., 16th March and 5th April, were done with irrigation in both *capsularis* and *olitorius*.

The data were statistically analysed and it was found that the April sowings gave significantly higher yield of fibre than other sowings in both *capsularis* and *olitorius*. With irrigation facilities, *capsularis* can be sown profitably even by the middle of March, whereas in case of *olitorius* this period extends from April to middle of May. In *olitorius*, sowings in the earlier part of April gave the highest yield. Late varieties of both *capsularis* and *olitorius* proved significantly superior to early varieties. This year's results confirm the findings of the previous year.

GREEN MANURING.

To study the effect of green manuring on yield of jute and paddy or both under West Bengal conditions a model scheme on 'Improvement of green manuring crops' sanctioned by the Indian Council of Agricultural Research for a period of 5 years was taken up in 1953-54. The main aim of the scheme is to study the agronomical aspect of green manuring.

The following studies were undertaken during the year under report.

1. *Maintenance and observations of species and varieties of green plants.*—Thirtyseven samples of seed of green manure crops collected from different parts of India were grown in observation plots. Dhaincha (*Sesbania aculeata*), cowpea, Kalai (*Phaseolus mungo*), Sunn-hemp and ground nut gave good performance so far as the quantity of green matter was concerned. A sample of Sunn-hemp received from Nagpur appeared to be quite promising.

2. *Yield trial of types found promising as a result of the observation under item 1.*—Out of 31 types of green manuring

crops tried in the observation plots in the previous year, 3 were found to be promising with regard to the yield of green matter. These types which belonged to kali kalai (*P. mungo*), pillipesra and sunn-hemp were included in a yield trial against cowpea and dhaincha and were found to do well as compared to the controls.

3. *Preliminary studies on the possibilities of growing various green manuring crops in relation to its time of sowing between standing jute rows and crop (jute) age.*—Different green manuring crops were sown with the last interculture between standing rows (12", 15" and 16" apart) of *capsularis* and *olitorius* jute. Sunn-hemp, cowpea and kalai (*P. mungo*) sown between jute rows of shorter heights tended to give slightly better performance. Pillipesra gave encouraging results when sown between rows of jute which were 15" and 18" apart.

4. *Study of the comparative efficacy of green manures alone or in conjunction with fertilizer on yield of paddy.*—The treatments included two green manuring crops, dhaincha and cowpea with or without fertilizer, followed by paddy. A mixture of ammonium sulphate, single superphosphate and muriate of potash was applied so as to give 20 lb N, 60 lb P_2O_5 and 25 lb K_2O per acre. Application of fertilizer mixture was done to (1) green manuring crops direct, (2) to green manuring crops at the time of sowing and (3) to paddy direct. One treatment with paddy alone without green manure crop or fertilizer and another treatment with jute followed by paddy with or without fertilizer mixture were also included in the trial. Highest yield of 35.82 maunds per acre was obtained from paddy when the fertilizer mixture was added direct.

5. *Study of the optimum date of sowing and age of green manuring crops for incorporation when sown pure or intercropped with jute in relation to yield of paddy.*—The treatments included two dates of sowing of dhaincha and cowpea at an interval of 20 days, beginning from 27th June, 1954. The green manuring crops were sown either alone or in between rows of *capsularis* jute followed by paddy. The treatments, paddy alone, and

paddy after jute were also included in the experiment besides a treatment in which jute tops were incorporated in the soil at the time of the harvest of jute.

Of the green manuring crops sown between standing jute rows, cowpea gave better performance than dhaincha. It gave equally good results as that of dhaincha or cowpea sown alone so far as the yield of paddy is concerned. All the treatments were found to be better than control.

6. *Study of the optimum date of sowing and age of green manuring crops for incorporation when sown pure or inter-cropped with jute in relation to yield of wheat.*—The treatments included two dates of sowing of dhaincha and cowpea at an interval of 20 days commencing from 22nd June 1954. The green manuring crops were sown either singly or in between rows of *olitorius* jute followed by wheat. The treatments, wheat alone and wheat after jute were also included in the experiment besides treatments in which jute leaves and tops etc. were incorporated in the soil at the time of the harvest of jute.

Early sown dhaincha alone gave the highest yield of green matter, but cowpea proved superior to dhaincha when the two were sown in standing jute row. Of the green manuring crops sown in standing jute rows, cowpea gave better performance than dhaincha and it gave equally good results as that of dhaincha or cowpea sown alone. All these treatments were found to be superior to the control.

7. *Study of the effect of green manures and other manures (both organic and inorganic) on yield of paddy.*—To study the comparative effects of green manuring crops, inorganic fertilizers and different organic manures, a trial was conducted in a simple randomized block layout. The treatments included fertilizers, oil-cake, F.Y.M., compost, sludge (at 20 lb. available N) used direct to paddy. With regard to fertilizers, a mixture of ammonium sulphate, single superphosphate and muriate of potash was applied at the rate of 20 lb. N, 60 lb. P_2O_5 , and 25 lb. K_2O per acre. Dhaincha and cowpea were incorporated in the soil with and without the application of lime (200 lb. per acre).

Highest yield of 34.70 maunds per acre was obtained from paddy when it was green manured with cowpea. The treatments of dhaincha compost and F.Y.M. were found to be significantly superior to the control.

VI. SOIL, BIOCHEMICAL AND MICROBIOLOGICAL STUDIES

1. Quality of fibre

Colouration of fibre.—The laboratory scale experiments carried out to study the influence of pH on colouration of fibre was continued. It was found that the tannin content of the fibres (the amount was varied by impregnating the fibres previously in solution containing different concentration of tannic acid for varying periods of time) and the iron content of the retting water also influence to a certain extent the range of pH at which there is maximum colouration or minimum colouration of the fibre.

It was reported last year that a treatment with 2 per cent tamarind extract for a period of 5 minutes is sufficient to remove the *shamla* colour. This year the work was carried out to study the residual effect of the tamarind extract in removing *shamla* colour of additional quantities of fibre and also its costings in semi-pilot scale experiments. It has been estimated that under normal circumstances 2 persons will be able to handle about 8 maunds of fibre with 5 seers of tamarind and 3 cft. of clean water. An earthenware vat capable of holding about 2 cft. of water will be necessary. This operation will cost about ten annas per maund including wages @ Rs. 1/10/- per day. The fibres have been sent for technological tests.

Work was continued with different varieties to study their tannin absorption and retention capacities at different pH values.

Edaphic factors.—The quality test report of the samples of fibres from plants grown at Chinsurah (West Bengal), Bansdih (Assam), Gograghat and Muzaffarnagar (U.P.) retted and ex-

tracted under Barrackpore conditions show that of the three *capsularis* and two *olitorius* samples, the quality ratio of the plants grown in heavy clay soils of Chinsurah which is richer in available phosphate are better than that of fibre samples from lighter soils of other places.

During this year, green jute stems obtained from Kendrapara (Orissa), Manoharpur (Hooghly, West Bengal), Gothmilki (Purnea, Bihar), Belakoba (Jalpaiguri, West Bengal) and Tamkohi Road (U.P.) were retted and fibre extracted under Barrackpore conditions. Samples have been sent for technological tests and the results are awaited.

2. Retting of jute

(A) *Action of different activators on retting of jute:*

(a) *Effect of natural and synthetic activators on retting:*

(i) *Effect of bone dust and ammonium-sulphate.*—The controlled retting tank was constructed late during the period under report and it was possible to carry out only one experiment. It was found that retting period in the treated tanks was reduced to 70 per cent of the control, which took 28 days. Temperature during the period was low being a maximum of 27°C (81°F) and a minimum of 10°C (50°F). The treatment consisted of 2 gms. per litre of ammonium-sulphate together 2 gms. per litre of bone dust.

From other experiments, it was found that plants contained more nitrogen if nitrogenous fertilizers were added. It was considered, therefore, that when bone dust, ammonium-sulphate and compost were added to the soil, the retting period of plants grown on them might be affected. It was tentatively found that though plants obtained from plots where ammonium-sulphate was added were bigger, the retting period was rather less than that of the plants grown in other plots. In a preliminary experiment, ammonium-sulphate and sodium-nitrate were added to the plots a week before harvest and the harvested plants were divided according to their base diameter and height. Plants from plots treated with ammonium sul-

phate tended to ret quicker whilst those from plots receiving no fertilizer took the longest period.

(ii) *Effect of natural substances.*—In a preliminary experiment *Dhaincha* (*Sesbania aculeata*) and sunn-hemp (*Crotalaria juncea*) stems, which take much shorter time to ret, were put in the bundles of jute (for every 10 jute stems, one *dhaincha* or sunn-hemp stem was added) and were allowed to ret. In some of the retting vats bone dust was also added. It was found that sunn-hemp alone or with bone dust reduced the retting period most and took rather less time than ammonium-sulphate and bone dust in combination. *Dhaincha* alone or with bone dust reduced the retting period which was almost the same as ammonium-sulphate and bone dust in combination.

(iii) *Effect of trace elements.*—The effect of boron (both as boric acid and borax), molybdenum (as ammonium molybdate), zinc (both as zinc sulphate and zinc chloride), selenium (as sodium selenate), cobalt (as cobalt acetate), manganese (both as manganous sulphate and potassium permanganate), magnesium (as magnenium sulphate), copper (as copper sulphate) and potassium persulphate on retting period were studied. Cobalt nitrate was not used as it was not found to be effective at any of the concentrations studied previously. As it has already been reported that 100 p.p.m. of these are possibly toxic to micro-organisms and have no effect in reducing the retting period, this year only concentrations of 10 p.p.m. and 1 p.p.m. were used in this study. Of these salts, potassium persulphate at 1 p.p.m. concentration was found to be best. Zinc chloride and ammonium molybdate at 10 p.p.m. was found to be better than at 1 p.p.m. concentration ; behaviour of other salts was somewhat irregular.

(b) *Survey of retting water.*—43 samples of retting water were collected from Tarakeswar (Hooghly), Nilganj, Baraset, Basirhat, Habra (24-Parganas) and Fulia (Nadia) areas in West Bengal to study their chemical constituents as well as the micro-organisms. Dissolved oxygen, pH, phenolphthalein alkalinity, methyl orange acidity, water-soluble inorganic

phosphorus, nitrate and ammoniacal-nitrogen, ferrous and ferric iron were estimated. Nitrate and ammoniacal-nitrogen content were found to be in most cases of the order 5-6 p.p.m., but water soluble inorganic phosphate varied considerably. In cases where there has been retting for a considerable time this value was often more than 100 p.p.m.

(c) *Retting without steeping.*—*Macrophomina phaseoli* and several strains of fungi belonging to Aspergillaceae were tried. The fungi were sprayed on the stacks of jute stems with or without bone dust, ammonium sulphate, wheat bran, singly or in combination. The fibre obtained was not uniform in strength and rather coarser than the usual steep-retting and often the fibres stick together and a 'barky' or 'rooty' fibre is obtained. Further work is in progress.

(d) *Biochemical changes during retting.*—During retting, the soft tissues between the fibres bundles break down and any improvement in retting technique should be dependent on the study of the materials in them and their decomposition. It has been found from a preliminary experiment that though pectins are water soluble (hot or cold), repeated extractions with hot water do not loosen the fibres completely but a treatment with 4% alkali does so. This shows that not only pectins but also hemicelluloses are these materials between the fibre strands. The influence of different micro-organisms responsible for retting of jute on the nature and rate of decomposition of pectins and hemicelluloses is being studied.

The study of biochemical changes during retting, and the work carried out previously showed that normally, if the retting water be neutral or slightly alkaline, the retting process would be quicker. During the period under report, the range of pH studied was 3.0 to 9.0 instead of 6.0 to 8.0 as studied previously. It was found that at very low pH values (3-4) in acid range and at pH value near about 7.0 (*i.e.* neutrality) retting period is the shortest whilst at values in between and above 7.5, retting is considerably slower. There is some residual effect at these two ranges of high acidity and neutrality.

(e) *Isolation and purification of micro-organisms.*—Five cultures of previous years were maintained. Of the 28 cultures isolated this year from retting waters, two have been found to possess retting properties. Several cultures belonging to Aspergillaceae and other families are being maintained for the extraction of extra-cellular and intra-cellular pectinases and hemicelluloses in order to study the catalytic effect on retting.

3. Analysis of soils and manures for their Chemical and mechanical constituents

(a) *Routine analysis.*—Routine analysis of 36 samples of manures, fertilizers, other materials and soils were done as and when required. In addition, 81 soil samples from different tentative sites of the proposed seed multiplication farm and substations were analysed and reported.

(b) *Soil survey.*—102 samples were obtained from Uttar Pradesh, Bihar, Assam, West Bengal and Orissa through the courtesy of the Directors of Agriculture of the respective states and the Director, Economic Research, Indian Central Jute Committee. Organic carbon and available plant nutrients were estimated. The variations are more or less similar to those reported last year. It is proposed to correlate these data next year with the yield and manurial responses.

4. Soil exhaustion studies

(A) *Soil exhaustion studies in double-cropping plots.*—To study the effect of growing jute on other succeeding crops, both with fertilisers and without fertilisers, a pot culture experiment was carried out. Wherever recommended practices of adding all leaves and other non-fibre producing portions of the stem to the soil was followed, the yield of the second crop was higher when jute was grown as a preceding crop provided the date of transplantation in case of paddy and date of sowing in case of wheat, mustard, pea and gram was the same in the treated and control pots. The soil-analytical data also showed that soils were in a better state of fertility if jute was grown as a preceding crop. If the fertilisers were given to jute, the second crop was benefitted more than if it was added before

the second crop. The fertilisers added were oil cakes (mustard, linseed, groundnut, castor) and ammonium-sulphate both singly and in combination.

(B) *Soil exhaustion by different varieties of jute.*—Even after three years of cropping, no marked differences in available plant nutrients, total nitrogen, organic carbon and pH have been observed in top soils due to growing of different varieties of jute. The varieties studied were JRC-212 and D154 (*capsularis*) and JRO-632 and C.G. (*olitorius*). Subsoils have been collected from each of the 24 plots and are being analysed plotwise.

(C) *Changes in nutrient status of soil:* (a) *In heavily fertilised lands.*—After three years of continuous cropping with jute and heavy manuring with a mixture containing equivalent amount of sodium nitrate and ammonium-sulphate (rate of nitrogen being 0 to 320 lb. per acre), the pH of top soil was 6.1 where maximum fertilisers were added. But in one plot it fell to 5.5. In case of lower doses, the pH comparatively was higher (6.2—6.6 depending on dose). In no manure plots, there was a slight or no change of pH value from the original 6.8 to 7.0. With higher doses of fertilizers, exchangeable calcium generally fell. Variation of organic carbon was more or less irregular in top soils. Subsoils were also collected from each of the 25 plots and their analyses are in progress. Where ammonium-sulphate at the rate of 0 to 90 lb. nitrogen per acre were added for three years to jute, the exchangeable calcium and pH was found to fall considerably. Variation of organic carbon was irregular. Though exchangeable calcium increased, it was not markedly higher in the case of plots treated with superphosphate (rate being 0 to 28 lb. phosphorus per acre), and cropped with jute for 3 years consecutively. Variation in organic carbon was more or less irregular. With compots the variations were irregular in the top soil. Subsoils from all the 45 plots are being analysed.

(b) *Soil nitrogen:* (i) *Chemical.*—It was found that soil nitrogen (both total and available) increases after a crop of jute

not only in Barrackpore soils (where total nitrogen was estimated plotwise in 72 samples drawn before and after jute from plots with different plot sizes, manurial treatments and varieties during three years), but also in soils obtained from other places and other types with which pot culture experiments were carried out. The different soils were obtained not only from jute growing tracts but also from other tracts through the courtesey of Directors of Agriculture of different States.

Composts prepared under partial aerobic conditions with thinned out jute plants was found to be better so far nitrogen is concerned. Further attempts are being made for better utilisation of thinned out plants.

(ii) *Microbiological*.—The sequence of changes of different forms of nitrogen and soil micro-organisms under the influence of ammonium-sulphate, compost and no manure in jute-cropped plots against no jute plots was studied. The variation was found to be more or less similar to that reported earlier. It may be mentioned here that the increase in available nitrogen occurred not exactly at a definite age of the plant but it also depended on weather. This increase in available nitrogen in jute-cropped plots occurs shortly after rate of leaf-fall increases.

(c) *Soil phosphorus*.—It was reported earlier that available and alkali soluble phosphorus increase after a crop of jute. The uptake of phosphates by jute crop is much in excess of what is present in the soil as determined by dilute acid extraction methods used largely for determining available phosphates for other crops, that is jute takes up not only easily soluble phosphates but may also take up difficultly soluble phosphates. Indian red soils often contain considerable quantity of total phosphate but are very poor in available phosphate and they usually do not respond to phosphatic manuring. It has been suggested that they may be improved by the addition of organic phosphates or by growing a green manure crop with phosphates. From earlier observations it was thought that jute may

improve the fertility status of such soils. With this point in view an experiment was started. Soils have been obtained through the courtesy of the Directors of Agriculture of West Bengal, Orissa, U.P., Andhra, M.P., Madras, Travancore-Cochin, Mysore, Hyderabad, Deputy Director of Agriculture of Damodar Valley Corporation and Administrator, Mayurakshi Project. Samples from other States are also expected soon. Some of the samples were received too late and were carried over for next year and experiments were conducted with samples from Bankura, Burdwan (West Bengal), Hyderabad (Deccan), Anandpur, Khurda, Salepur, Kendrapara (Orissa), Gograghat (U.P.), Pattambi (Andhra), Labhandi, Jabbalpur (M.P.), Hazaribagh (Bihar). In all these cases, in all the replicates, the yield of paddy and straw were considerably higher where jute was grown with or without ammonium-sulphate than those pots where no jute was grown, showing thereby that soils were in a better state of fertility if jute is grown as a preceding crop. This was also corroborated by soil analysis.

(D) *Withdrawal of nutrients by the jute plant:* (a) *Accumulation of inorganic nutrients in the tip leaves (shoot apex).*—Inorganic calcium, inorganic phosphate, ammoniacal and nitrate-nitrogen were estimated in the tip leaves (shoot apex). It was found that if any one of these ions was considered, there was not much correlation with soil data in plots heavily fertilized for three years ; this was possibly due to the fact that when one nutrient became too much or too less in comparison with others, the uptake of the nutrient was influenced to a great extent by the excess or deficiency or other nutrients also. Further work is in progress.

(b) *Uptake of total nitrogen by the plant.*—Total nitrogen was estimated in different parts of the plant with JRO-632 and the percentage of nitrogen was found to increase with nitrogenous fertilisers, though it was not proportional to the increase in the quantity of nitrogen added. Further work is in progress.

5. Development of methods for determination of nutrients for advisory work in connection with manuring

The method of determination of available phosphate, as reported earlier was further standardized and the effect of storage of samples on the amount of phosphate coming into solution was further studied. Experiments are in progress for the development of a rapid method for the determination of available nitrogen suitable for jute. In this connection it was found that the determination of organic carbon did not give definite clue to the fertility status of jute soils so far as nitrogen is concerned. A pot experiment will be started next year to find out the availability of nitrogen from different organic manures.

6. Role of soil conditions regarding susceptibility to diseases

It was reported that there is an indication that minor elements like boron may affect the susceptibility of jute plants to diseases. From test plots, where boron, zinc, copper, manganese, cobalt and molybdenum were added, it was found that in plots treated with these elements there was a slight increase in the number of diseased plants in all the plots except where copper was added. It also gave an indication that the quantity of these elements play an important role. In most of the cases the incidence of disease was more where lower doses of the particular element was applied. Though fibre yield recorded a slight fall in many cases the seed yield increased.

7. Attempts to find out the maximum production of jute under the influence of nitrogen

With progressively higher doses of nitrogen, yield per plant increased, but due to heavy incidence of disease, there was considerable loss in population and though the different fertiliser treatments were statistically as good all of them were significantly superior to the control (no manure), in yield. Due to continuous application of ammonium-sulphate and sodium nitrate for 3 years, exchangeable calcium fell considerably.

Further work is in progress in which a half of each plot will be limed to counteract the increase in acidity and fall in exchangeable calcium of the soil.

3. The influence of soil conditioners on soil texture

It was found that in the Barrackpore soil (sandy loam), with krillium and tamarind kernel powder, the water-holding capacity increased while compost, ammonium-sulphate and silicates, had very little or no effect. Further work is in progress with a heavy clay soil to study other aspects.

VII. DISEASES

1. Study of the effects of environmental factors on secondary infection due to *Macrophomina phaseoli*

The incidence of diseases like seedling-blight, collar-rot, stem-rot and root-rot in plants of different dates of sowing was periodically recorded. In general the incidence of diseases was low. Similar data collected during the last 3 years show that under conditions prevailing at Nilganj the early-sown crops, both *capsularis* and *olitorius*, become more susceptible to stem-rot and more so to root-rot, as compared to late-sown crops. It was found that pycnosporos could germinate and penetrate the leaf-tissue within 3-4 hours under favourable conditions. It has again been confirmed that leaf-infection spreads immediately after a shower if the temperature remains above 85°F; the symptoms, however, can only be detected at least 48 hours after the spores are lodged on leaves. These and other observations indicate that repeated sprays would be useful before and after showers. The most susceptible period for leaf infection is from 4th to 8th week.

2. Stud of the Stem-rot Fungus

(i) The growth characters of the eight forms of *Macrophomina phaseoli* (Maubl.) Ashby were studied. All the eight forms grew more rapidly in darkness than in diffused light. The form B45 proved to be a slow-growing saprophyte as compared to the other forms. The rate of growth of all the eight

forms was more at 35°C than at 23°C on Potato Dextrose Agar. At 23°C B61, B68, B50 and B46 had a comparatively better growth than the other forms, while B45 had practically no growth. Characters as developed on three different media viz., Potato Dextrose Agar, Corn Meal Agar and Jute-extract Agar showed that in general the mycelia in early stages were white and gradually turned grey to mouse grey ; in two of the forms, a very thin shade of pinkish-grey colour developed at late stages of growth. On jute extract Agar, growth was mostly appressed at 23°C but was thin wooly at 35°C. On P.D.A. mycelia became cottony to floccose at the edge, wooly in the middle and sometimes appressed at the centre. In general differences in media had pronounced effect on growth characters. Alternate periods of light and darkness produced zonations.

Sclerotia developed earlier in B61, B68 and B46 than in the other five forms. In B68 the sclerotia gave a greenishgrey hue in reflected light on P.D.A. In B45 and B43 sclerotia appeared very late and in the former the sclerotia were smaller, irregular in shape and less compact. In general P.D.A. gave a quick luxuriant growth and the vegetative phase was shorter as compared to that in Cornmeal Agar. Development of sclerotia in the latter was more uniform as compared to other media. Sclerotia formation on Jute-extract Agar was very scanty. Except B45 and B43, other forms cannot be distinguished on the basis of such growth characters. However, it was observed that significant differences existed in sclerotial measurement on the basis of which B68 and B45 could easily be recognised.

It was noted that process of sclerotia formation both in regard to size and number degenerated due to continued growth on artificial media through repeated subcultures.

(ii) In a pathogenicity test of the eight forms of *Macrophoma phaseoli* carried out under laboratory conditions, differences in virulence and mode of attack were observed. Tests were carried out with seedlings of JRO-632 (*olitorius*).

Under uniform conditions of humidity, temperature and quantity of inoculum, B43 proved to be the most virulent, closely followed by B46 and B50. All the isolates attacked the seedlings readily but B45 and B35 were slow to act. The results of the pathogenicity test are given in Table VII.

TABLE VII

Showing virulence of different forms of M. phaseoli under artificial conditions

Particulars about pathogen			Per cent seedlings infected or killed.		
Form No.	Host	Locality	3rd day.	7th day	12th day
B 11	<i>C. capsularis</i> (stem)	Chinsurah, West Bengal	10, infection	50, killed	100, killed
B 43	<i>C. olitorius</i> (seedling)	Memari, West Bengal	80, killed	90, killed	100, killed
B 45	<i>C. capsularis</i> (stem)	Nilganj, West Bengal	2, infection	10, infection	50, killed
B 46	<i>C. olitorius</i> (root)	Tarakeswar, West Bengal	50, killed	100, killed	...
B 68	<i>C. capsularis</i> Jap Red (root)	Nilganj, West Bengal	5, infection	40, killed	100, killed
B 50	<i>Hibiscus sabdariffa</i> (root)	Nilganj West Bengal	60, killed	100, killed	...
B 35	Host, unknown.	I. A. R. I. Delhi	3, infection	20, killed	75, killed

* Approximated to round figures.

Crude extract of toxins from the different forms were tested against *olitorius* seedlings. No definite conclusions were drawn regarding the toxicity of such extracts.

(iii) Jute (JRO-632) and potato were grown in the same plot for the third year. This year heavy mortality was recorded. Mortality due to the eight forms varied within the range

of 27 to 66 per cent. Records also clearly show that in jute-potato fields, the *Fusarium* sp. (Solani ?) plays a secondary role in causing epidemics, the primary pathogen being *Rhizoctonia bataticola* Taub. It was further seen that potato cultivation has a very important bearing on the epidemic root-rot of jute. Isolations of various micro-organisms from the infected and dead tissues were completed with a view to study their pathogenicity in jute, singly and in combinations, under controlled conditions.

3. Other diseases

(i) *Anthracnose of jute*.—3 selections out of 23 cultures were grown in a field heavily inoculated with the anthracnose-fungus (*Colletotrichum* sp.). The selections proved to be fairly resistant as there was practically no mortality. The damage due to infection was restricted as localised spots on the stem. Further selections were made.

A comparative study of the 3 types of cultures viz., *Colletotrichum capsici* from jute from Malaya, *C. capsici* from *Capsicum frutescens* from Coimbatore and the *Colletotrichum* from jute from Nilganj show that they differ in certain features both morphological and physiological. The failure of the Malayan type (B63) and Nilganj type (B55) to attack *Capsicum annum* and their differences from the type culture (B74) received from I.A.R.I., New Delhi, show that the former two are somewhat different. These two may be two different strains of a separate species. B63 has smaller conidia than B55. The former closely agree to the description of Ikata's *Colletotrichum corchorum* from Asakura shotem, Tokyo.

The indigenous types and varieties of *C. capsularis* are much less susceptible to *anthracnose* than the Japanese and Chinese materials grown in the Institute.

All the 3 type cultures of *Colletotrichum* have tendencies to throw saltants ; on artificial media variations in minor characters are often observed.

(ii) *Soft-rot caused by Sclerotium rolfsii* Sacc.—Work on the perfect stage of the fungus showed that the pathogen should be renamed as *Pellicularia rolfsii* Sacc. In general incidence of soft-rot has been low as compared to previous years.

(iii) *Fusarium* sp.—The *Fusarium* isolated from jute has been tentatively identified as *Fusarium solani* Kuhn. The isolate can attack the growing tips of stem, only when the roots are attacked with *Rhizoctonia*. Constant presence of the fungus in the xylem vessels of dead jute plants from epidemic area indicates its importance as secondary pathogen. Inoculation against mature plants, however, do not cause wilt under laboratory conditions. Its limitations as a secondary pathogen are still not known.

(iv) *Leaf-scald*.—Leaf-scald was widespread in all polyploid materials. The exact cause of the disease is still unknown ; but it appears to be due to some physiological reasons. The disease appeared when the temperature was about 100°F. Mortality was low. Most of the attacked plants recovered after heavy showers.

4. Chlorosis in jute

All previous attempts to induce chlorosis by smears have failed although transmission through grafts was successful. Intervarietal grafts have shown that differences in patterns of symptoms were mainly due to different host-reactions. 50 plants were inoculated by smears of crude juice-extract from chlorotic leaves with an abrasive prepared from finely powdered glass. Rubbing was done with a cotton-pad: After smear the plants were kept in darkness for 10 hours and subsequently were subject to normal field conditions. Positive transmission was observed in 6 plants after about 40 days.

It has previously been reported that chlorosis in jute is transmitted through seed. Selections from chlorotic type are now giving all chlorotic progenies. This process of selection in one direction has resulted in degeneration; the plants re-

maintained stunted, seed production per plant was low and the mortality during seedlings stage was significant.

Five F_1 selections and 15 back crosses carried forward from the crosses—chlorotic $\times$ non-chlorotic—were grown. The F_2 and back cross progenies segregated into chlorotic and non-chlorotic phenotypes during the early stages of growth ; but periodic counts revealed that many of the non-chlorotic progenies gradually changed into chlorotic and with the advent of the reproductive phase almost all the progenies became chlorotic.

31 selections were made in the F_1 , F_2 , back crosses and parental families for further studies.

5. Investigations on the method of control of diseases

(i) *Selection and breeding of resistant types.*—23 selections from improved *capsularis* types and 17 selections from improved *olitorius* types and 24 selections from other *capsularis* materials were sown in four separate randomized replicated trials. Sowings were completed by the third week of May. As in the previous year, there was a mixed infection of 'stem-rot', 'collar-rot' and 'anthracnose'. An attempt was made to identify the diseases of 'stem-rot' and 'anthracnose' on the basis of macroscopic symptoms alone. It was found that although distinction between the two could be made at earlier stages, no differentiation was possible in the advanced stages of growth. Hence the data of infection could not be classified under separate heads of diseases. However, 59 selections were made from the *capsularis* materials.

In the *olitorius* types mortality was heavy. Ten selections were brought forward.

(ii) *susceptibility of different jute strains and varieties to diseases.*—Incidence of diseases in various improved types and genetic strains were recorded. The results are given in Table VII.

TABLE VIII

*Diseases due to *Macrophomina phaseoli* in
capsularis varietal trial*

<i>Variety</i>	ϕ	<i>Mean disease per cent</i>
JRC-918	...	3.8
JRC-321	...	9.3
JRC-212	...	12.7
D154	...	13.2
JRC-13	...	15.4
Fanduk	...	16.5
JRC-919	...	16.7
JRC-1	...	58.1

From the table it is seen that JRC-1 is highly susceptible to diseases. All the improved *olitorius* strains had 5 to 6 per cent root-rot. Susceptibility of the different genetic materials to different diseases was studied.

(iii) Various commercial fungicides developed from cuprous oxide, copper oxy-chloride, colloidal copper and thiocarbamates together with Bordeaux mixture were tried against secondary infection of *Macrophomina phaseoli* in a replicated field trial. Bordeaux mixture, copper oxide and colloidal copper proved to be more efficient than others in preventing leaf infection; oxychloride proved quite satisfactory under laboratory conditions but was not so efficient under field condition.

6. Storage of seeds

A field trial was conducted to study the effect of prolonged storage of seed under different conditions on the yield of fibre. Seeds of different cultivated types, stored under different conditions for different lengths of time, lost viability to different extents. Crops were raised from such seeds after proper adjustment of seed rates. A very detailed record collected at different stages of growth showed that age of seed (at least up to 3 years has no influence on the time of flowering. Old seeds which have lost viability to certain extent, by adjustment

of seed rate, can give a normal stand, the yield of which is comparable to any normal crop. The growth curves as represented by height records taken at regular intervals show that there is practically no difference between the crop raised from old and fresh seeds.

It is important, however, that all old seeds must be tested prior to sowing. A sample in which all the seeds germinate simultaneously with uniform growth of radicles, can be safely used for raising crop after proper adjustment in seed rate.

VIII PETSTS

1. *Nupserha bicolor* ssp. *postbrunnea*

(i) *Varietal susceptibility of jute to the pest.*—In order to study the preference shown by the pest to different varieties, incidence of the pest was recorded monthwise from a trial conducted with five *olitorius* and five *capsularis* varieties as test materials in the same layout. The varieties of *olitorius* jute were C.G., R-26, JRO-620, JRO-632 and JRO-753 while the *capsularis* varieties were D154, Fanduk, Jap Red, JRC-212, JRC-321. All the *olitorius* varieties were attacked in different degrees, but the *capsularis* varieties though grown in the same layout were not attacked by the pest suggesting their resistant nature. Amongst the *olitorius* varieties, C.G. showed the highest degree of susceptibility and this was maintained almost throughout the entire jute season. The maximum incidence noted on C.G. was 14.05 per cent. JRO-632 and R-26 showed comparatively low incidence during the season. Activity of the pest was highest during the months of August-September. The varietal differences during different stages of growth are shown in Table IX.

TABLE IX

Per cent attack by Nupserha during different stages of crop growth

Name of the variety	One months growth stage	Two month growth stage	Three months growth stage	Four months growth stage
<i>Olitorius</i>				
C.G.	2.84	10.44	14.05	10.21
R-26	1.04	3.38	8.29	8.29
JRO-620	0.54	4.59	8.92	10.62
JRO-632	0.74	5.12	7.05	8.41
JRO-753	2.63	5.84	9.63	11.94
<i>Capsularis</i>				
D154	nil	nil	nil	nil
Fanduk	"	"	"	"
Jap Red	"	"	"	"
JRC-212	"	"	"	"
JRC-321	"	"	"	"

(ii) *Effect of different levels of manures on the incidence of the pest.*—Observations were recorded on the incidence of the pest from the NPK *olitorius* trial of the Agronomy Section where N, P & K were used either alone or in combinations. No definite conclusions could be drawn from the data obtained regarding the effect of N, P, K or their combinations on the incidence of the pest. Further observations will continue.

(iii) *Effect of variety-cum-spacing-cum-manuring on the incidence of the pest.*—Observations were recorded on the incidence of the pest from variety-cum-spacing-cum-manurial trial, conducted by the Agronomy Section. The varieties used in the trial were C.G. and JRO-632. The incidence of the pest was found to be more in broadcast sown treatments than

those sown in lines. Not much difference was obtained in line sown treatments with different spacings. The broadcast treatment with C.G. showed higher incidence than those with JRO-632.

(iv) *Loss of fibre yield due to varying proportions of damage at two stages of growth.*—To estimate the loss of fibre yield due to varying proportions of damage done at two stages of growth viz., 150 cm. height stage and 200 cm. height stage damage was artificially inflicted at the proper stage. The trial had to be rejected as the crop was very ununiform due to soil heterogeneity and no definite conclusions could be drawn.

(v) *Habitat of the pest during winter.*—Investigations were continued to find out where the insect passes the winter under the field condition. 8000 stubbles of *olitorius* jute were examined but no phase of the pest could be found in them. Studies in the laboratory showed that the borer larva during its prediapause stage cut the stem into small pieces and this provided the clue that the larva under the field condition might get detached and drop down from the host plant. Extensive field investigations were carried out in various *olitorius* tracts and it was found that the borer at the advent of winter during its prediapause stage cut the stem at two levels, above and below its body length and dropped down to the soil surface from the host plant.

During the winter season, i.e. after the harvest of jute, pieces of stems containing the diapausing larva were collected from soil both in the Institute's farm and the cultivators' fields from various places. These pieces of stems usually varied from about one to six inches in length and could be easily distinguished from others by the fact that the two ends of such pieces are plugged with fine chips of wood. It is of interest to note here that the borer larva saves itself by this process from sure extinction from drowning as otherwise it would have gone under water along with green jute steeped in water after harvest.

(vi) *Diapause stage and soil depth.*—As diapause stage is passed in soil during winter, laboratory observations were made with the dormant larvae to find out if these can survive under varying depths of soil with and without the casing made of jute stem. It has been observed that the larvae can survive under soil for more than a year. Maximum soil depth tried was 9" from surface. The larvae, even without casings, can survive about 4 months.

(vii) *Factors eliminating diapause.*—Factors which are responsible for eliminating diapause have an important bearing on the emergence of the adults. Investigations are in progress to ascertain the factors responsible for breaking the dormancy of the larva.

(viii) *Investigations on control.*—(a) *Destruction of diapause stage*—As the pieces of stems containing the dormant larvae get detached from the host plant, they remain scattered on the surface soil in an affected plot till the land is ploughed again after the harvest of jute. It may be possible to control to some extent the incidence of the pest by collecting and destroying the small pieces of stems containing the borer.

(b) *Use of resistant type.*—Laboratory trials were repeated with all the known *capsularis* varieties as host materials to test the resistance to the adult pest. Results obtained confirmed previous year's observations that all the varieties of *capsularis* jute are resistant to adult. Cultivation of *capsularis* varieties may be resorted to in an affected area if the type of land be suitable for such purpose. Further studies with *capsularis* varieties are in progress.

(c) *Use of insecticides as prophylactic.*—A trial was conducted to determine the effect of different insecticides in preventing the incidence of the pest under the field condition. Application of different insecticides were given at regular intervals and pest incidence recorded. High mortality of the trial crop due to root-rot in most of the treatments vitiated the result. The trial will be repeated.

(ix) *Parasites*.—Observation on the extent of parasitisation under field condition was continued. The parasite *Neocatolaccus* sp. was found to be the most important amongst the different parasites so far recorded. Its maximum activity was noted during the month of August when 24.90% larvae and/or pupae were parasitised. Extent of parasitization by *Ipobracon* sp., *Goryphus* sp. and *Spathius* sp. was very negligible, and activity of these parasites was restricted to the month of August only. Periodicity of parasitisation by *Neocatolaccus* sp. ranged from July-October. Attempts made to breed the parasites on other hosts have failed so far.

2. *Pseudococcus filamentosus* var. *corymbatus*

The pest causing serious damage to jute was for the first time reported from Baduri (24-Parganas, West Bengal. It was identified as *P. filamentosus* Ckll. var. *corymbatus* Gr. Studies on this pest were taken up as it causes serious damage to both *capsularis* and *olitorius* jute. As a result of the damage the plants become stunted and the stem often shows helicoid growth.

(i) *Phase responsible for damage*.—The pest was multiplied under laboratory conditions and subsequent tests were made for determination of actual phase responsible for inducing the serious malformation and damage to the crop. Test-infectations were made to both *olitorius* (C.G.) and *capsularis* (D154) jute with different instar nymphs of the pest and records maintained on plant growth, development of damage symptoms etc. It was found that the first instar nymphs could induce damage symptoms, thus representing the destructive phase in the life-cycle of the pest. Later instars or adults were not observed to be associated with such damage.

(ii) *Susceptible region of damage*.—Though the pest feeds on any part of the host plant, damage or abnormal development was only induced when feeding of the first instar nymphs was restricted to the growing tip of the plant.

(iii) *Effect of damage on height and internodal length*.—Damage by the pest causes inhibition of the vertical growth of

the plant by arresting the growth of the internodal length in general and of the affected portion of the stem in particular. Though the average number of internodes were more or less equal in both affected and normal plants, in an affected plant the average length of the internode was reduced. The average length of the internode was found to be 5.6 cm. in a healthy plant. In an affected plant the average length of the internode in the non-affected portion was 3.74 cm. and in the affected portion it was 0.50 cm. The affected plants, therefore, were stunted and had an average height of 29.3 cm. whereas the normal plants were of 170.9 cm.

(iv) *Effect of damage on tissues*.—Examination made in different tissues in cross sections of affected portion of damaged plants *vis-a-vis* normal plants, showed that the injury induces a number of changes in the tissue structure. There was, in general, increase in the number of cell layers.

3. Selection for resistance to *Apion corchori*

Some of the selections in the *capsularis* trial were found to be better though significant difference was not observed. In the *olitorius* trial not much difference was observed amongst the selections. Fresh selections were made.

4. Time/dosage/instar/mortality relationship

Study on the dosages of different insecticides and their effect on the mortality and the time required for this with reference to different instars of different caterpillar pests, was taken up. For want of staff and accommodation, only preliminary observations could be taken on one instar of *A. sabulifera*.

5. Extent of removal of vegetative matters by the caterpillar pests during different instars

Preliminary observations were made with regard to removal of vegetative matter by different instars of *A. sabulifera*. It has been observed that the third instar removes maximum vegetative matters from the host and as such is the most destructive.

6. Relationship of pH of the soil and pupa formation of *A. sabulifera*

Preliminary laboratory experiment was carried out to determine the pH range of soil preferred by the last instar larva of the pest for pupa formation in soil. pH range was changed for experimental purposes by application of different doses of sulphur dust and lime. Further observation will continue.

7. Nematode (*Heterodera marioni*)

(i) *Depth distribution*.—Observations were in progress regarding distribution of this nematode in different soil depths so as to enable application of nematocide in correct soil depth *i.e.* the zone of maximum habitat in a particular period of the year. Preliminary observation indicated that the depth near about 6" below the surface is much preferred by the pest. Further work will continue.

(ii) *Effect of nematocide*.—Laboratory tests were carried out in pots to find out the effect of the nematocide—DD—on the pest. The nematocide was applied 6" below the surface soil in heavily infected soil samples. Of the various dosages applied, 400 lbs. per acre was found to give 100% mortality in about a fortnight as indicated in preliminary tests.

(iii) *Effect of DD on plant growth*.—Preliminary observations were made during winter months on the effect of DD, applied in soil, on the germination and on the seedlings of both *capsularis* and *olitorius* jute. No immediate adverse effect was observed. Further study will continue.

8. New records

A new type of mite was observed for the first time on jute. Though this mite caused damage to the apical leaves and buds but the symptoms produced were different from those of *Hemitarsonemus latus*. In the present case, leaf-lamina do not develop properly resulting in very close imposition of mid-rib and veins. Such leaves also curl in different manners. Lime-sulphur (3 : 1) is effective against these for control.

IX. THE JUTE PEST AND DISEASE CONTROL SCHEME, TARAKESWAR.

An area of 300 bighas (100 acres) of cultivators' land was brought within the scope of the scheme, 284.5 bighas were under jute (*C. olitorius*) ; about 6.5 bighas were under paddy. Of the total jute area, crop failed in about 5 bighas due to inadequate agricultural operations. This year for the first time *Hibiscus sabdariffa* was grown in this locality in an area of 1.2 acres.

The total rainfall was 51 inches with a distribution of rainy days as follows ; January-2, February-1, March-nil, April-1, May-6, June-14, July-11, August-16, September-11, October-4, November-nil, December-1.

Sowings were taken up on 30th April and in the 1st, 2nd and 4th week of May. Harvest was done between 10th August and 13th September. The retting period varied from 14 to 30 days. About 11 bighas were sown in line with the help of drills. Nearly 35 seers of seeds of improved strain JRO-632 were distributed amongst cultivators for demonstration. Results were highly satisfactory. Need for supply of drills at cheaper rates was felt, as the present prices are beyond the capacity of average cultivator of the area.

Diseases.—In general, this year the incidence of root-rot was higher than that of the previous year. The control measures included clearing of stubbles, for which purposes the use of 'bida' [bullock-driven rake] was introduced in the area ; application of lime and muriate of potash and spray of cuprous oxide were also done. Besides the above, proper drainage was arranged wherever conditions permitted. One notable feature was complete absence of seedling blight within the area under the scheme. As a routine practice the seeds are dressed with a heavy coating of organomercuric compounds.

Pests.—As in previous years, cultivators took much interest in pest control activities ; as usual sprayer and dusters were also loaned for temporary use to cultivators whose plots were included

in the scheme. The cultivators of the area have become so very conscious about the necessity of control measures, that no untreated plot was available for use as control plot. As a result, trial on the loss of yield due to pest damage, in the locality, had to be abandoned.

Due to the effective demonstrations in controlling pests carried out in this area for the last few years, there had been a demand of D.D.T. (wetable form) among the cultivators and this product is now available even in the local markets.

To demonstrate the comparative efficiency of common insecticides in different forms, sprayings or dustings were given in 24 different plots.

Intensity of attack by various pests was lower than the previous year as shown below. This is based on observation made on 279 bighas or 93 acres.

Percent incidence.		Acreage under attack.			
		<i>Semilooper</i>	<i>Mite</i>	<i>Apion</i>	<i>Indigo caterpillar</i>
1 — 3	...	42.63	23.56	13.11	7.17
4 — 20	...	15.30	1.79	0.41	0.36
21 — 40	...	0.47	—	—	—
41 and above	...	—	0.45	—	—

Incidence of *Nupserha bicolor* ssp. *postbrunnea* also increased considerably. During winter a survey was made in the locality to find out the proportions of diapausing larvae in different fields under different crops i.e. under different types of agricultural operation. It was found that number of diapausing larvae was more in fields under pulses than those under potatoes.

X SUBSTITUTE FIBRES

I. BREEDING AND GENETICS.

A. *Hibiscus cannabinus* and *Hibiscus sabdariffa*

(i) *Collection of materials*.—The following samples of seeds, both indigenous and exotic were received during the period : *Hibiscus cannabinus*—20, 17 from Andhra State and one each Midnapore, Orissa and Ibadan ; *Hibiscus sadariffa*—10, eight from Andhra State and one each from Burdwan and Ibandan ; *Hibiscus lunarifolius*—Two, one each from Aden and Kenya Colony ; *Hibiscus panduraeformis*—one from Kenya Colony.

The 17 samples of *H. cannabinus* received from Andhra State and one from Midnapore could not be sown as they were received late in the season. The two samples from Orissa and Ibadan had good germination. As all plants raised from the Orissa sample died due to heavy attack of stem-rot before flowering, seeds could not be collected. The plants raised from the Ibadan material attained on an average good height and base diameter. 8 samples of *H. sabdariffa* were received late in the season and could not be sown. Two samples, one each from Burdwan and Ibadan had good germination. The plants raised from Ibadan seeds were, however, bushy and dwarf in habit and the fruits were found to be of the common edible type. The performance of the Burdwan material was satisfactory but there was heavy incidence of stem-rot towards harvest stage. The seeds of *H. lunarifolius* received from both Aden and Kenya colony had fair germination and their growth performances were satisfactory. The seeds of *H. panduraeformis* had fair germination. The plants raised were bushy and their stems and petioles were found to be hairy.

(ii) *Progeny-row tests*.—Four progeny-row trials, two *cannabinus* and two *sabdariffa*, were started this year. Germination in all the trials was fairly good. Necessary records were kept. The trials were harvested at 50% flowering stage. A total of 2472 secondary selections were made in these trials. Pigmentation, leaf character, date of first flowering, height,

base diameter of plants were recorded for each selection. As a result of heavy stem-rot attack at late stage of growth both the *cannabinus* trials were rejected. From both the trials of *H. sabdariffa* six cultures were carried forward.

Besides the above selections, a fresh selection of 437 and 166 in *H. cannabinus* and *H. sabdariffa* respectively based on maturity, pigmentation, leaf shape, plant height, base diameter, and resistance to diseases, pests and water-logging were also made from different F_2 and seed plots and type plots.

(iii) *Small scale yield trial.*—The trial was repeated with two local selections against two foreigns trians as in the last year. The results are given in Table X.

TABLE X.

Yield trial of H. cannabinus.

Layout—Replicated randomized blocks in 6 replications.

Effective plot size—1/414 acre.

Date of sowing—7.5.54.

<i>Treatment.</i>	<i>Fibre yield per acre (Md.).</i>	<i>Percent on control.</i>	<i>Date of harvest.</i>
Mesta Gr.5 (Control)	13.13	100.00	2.9.54
Kenaf, India Supply			
Mission	12.17	92.69	10.9.54
Mesta Gr. 3	11.94	90.94	2.9.54
Kenaf, La-Plantation	10.35	78.83	10.9.54
P — Large			
S.E.% — 3.56			

(iv) *Varietal trial.*—A varietal trial with 5 types of roselle against the control *H. sabdariffa* var. *altissima* was conducted in replicated randomized blocks. The results are given in Table XI.

TABLE XI

Layout—Replicated randomized block with 4 replications.

Effective plot size—1/71 acre.

Date of sowing—20.5.54.

Types	Fibre yield per acre (Maund).	Percent on control	Date of harvest
R.T. 26	21.70	112.84	6.12.54
R.T. 2	20.75	107.90	"
R.T. 59	20.18	104.94	"
R.T. 58	19.66	102.24	"
Control	19.23	100.00	1.12.54
R.T. 40	16.05	83.46	22.12.54
P	0.01		
C.D.	3.13		
S.E.%	3.83		

R.T. 26 has given the maximum fibre yield, but it is statistically at par with all the other types excepting R.T. 40 which has given about 17% lower yield of fibre than the control.

(v) *Interspecific hybridization*.—66 interspecific crosses of the previous year between *H. radiatus* × *H. cannabinus* were grown. Germination of the F_1 s was not very satisfactory and only 25 F_1 families germinated. F_1 s were also found to be highly sterile and the percentage of seed setting was very low. 22 F_1 selections were carried forward for further study. Out of 125 back crosses attempted only 31 were successful.

21 F_2 families and 11 back cross progenies of *H. radiatus* × *H. cannabinus* cross were grown during the year. None of the back cross families germinated. Out of the 21 F_2 families grown only 17 F_2 plant population with four phenotypic combinations were obtained. The F_2 data, could not however, be classified. Six F_2 selections have been carried forward.

830 fresh interspecific crosses between different species of *Hibiscus* were attempted and only 68 successful crosses obtained.

(vi) *Inheritance of character.*—(a) *Anthocyanin pigmentation.*—36 F_2 families consisting of six combinations of pigmentations and 10 back-cross families in *H. sabdariffa* were studied and classified. 85 fresh crosses and 42 successful back crosses were obtained in *H. sabdariffa*.

Seeds of six selections having flowers with white stigma and light pink centre of corolla made last year in *H. cannabinus* were grown and their progenies were found to breed true. Five successful fresh crosses between flowers having white stigma and light pink centre with normal flowers were obtained.

(b) *Earliness.*—10 back crosses, 16 F_1 sections of the previous year between early X late maturing strains of *H. cannabinus* and their parents were grown and studied. Two promising early selections were further made from the F_2 progenies. 19 successful fresh crosses between early and late strains of *H. cannabinus* and 16 back crosses have been obtained.

(c) *Leaf shape character.*—46 F_2 families and 15 back cross families between palmately-lobed and partially-lobed types of leaves in *H. sabdariffa* were grown and classified. As in the previous year a monogenic difference between palmately-lobed and partially-lobed type was obtained. 12 successful fresh crosses between palmately-lobed and partially-lobed leaf in *H. cannabinus* were obtained.

B. Other fibres

Collection of types.—The following samples of seeds and other propagative materials were obtained from different sources. Sunn-hemp (*Crotalaria juncea*)—one each from Andhra State and Kanpur ; Linseed-flax (*Linum usitatissimum*)—two samples from Indian Agricultural Research Institute, New Delhi ; *Agave sisalana*—100 suckers from Orissa and *Agave veracruz*—800 suckers from Ranchi district.

Seeds of sunn-hemp from Andhra State were grown during the winter season and stray attack of wilt disease was recorded in this collection. Sunn-hemp seeds from Kanpur will be grown during the next season. Two samples of linseed-flax received from Indian Agricultural Research Institute, were grown for observation during the winter season and the necessary characters were recorded. Suckers of both *A. sisalana* and *A. veracruz* received from Orissa and Ranchi respectively were planted in the nursery plots.

(i) *Sunnhemp*.—Morphological characters of 7 sunnhemp types were recorded. The seeds of all these types were also multiplied during winter season on small scale.

Varietal trial of Sunnhemp.—A varietal trial with one of our Sunnhemp type, S.T. 112, along with one improved strain K-12 and two local strains of U.P. was conducted in replicated randomized blocks at Naibazar, Banaras district during the year. Unfortunately, the trial had to be harvested after about 2 months from date of sowing due to the attack of "kali" disease. The observed differences in the yield of fibre were significant. K₁₂ has given the highest yield of fibre but it is at par with S.T. 112. Both K-12 and S.T. 112 gave significantly higher yield of fibre than the local strains.

Other Crotalaria spp.—Morphological characters of the other species of *Crotalaria*, namely, *C. striata*, *C. incana*, *C. veracossa*, *C. anagyroides* were also recorded. Of these species, *C. anagyroides* and *C. striata* gave tall plants and *C. incana* produced bushy and succulent plants. The former two species seem to be more suitable for fibre purpose while the latter two are probably better suited for green manuring.

(ii) *Linseed*.—(a) 17 dual purpose linseed strains were grown for observation and records on germination, branching habit, pigmentation of salyx, corolla, filament anther, ovary, style and seed-coat colour were taken. The two new samples of dual purpose linseed received from Indian Agricultural

Research Institute were found to be already in our collection. They were, however, grown during the season.

An yield trial with 17 strains of linseed was conducted during the year. This experiment was, however, abandoned in order to facilitate the levelling work in the farm.

(iii) Ramie.—Fresh ramie slips were obtained from the old plantations. Seedlings were raised from seeds and their morphological characters were studied.

(iv) *Agave spp.*—Preliminary studies of the leaves of different *Agave spp.* maintained in the Institute were made.

II. AGRONOMY.

(i) *Date of sowing experiment.*—This experiment was conducted in replicated randomized blocks with 4 replications with both *H. cannabinus* and *H. sabdariffa* var. *altissima* sown at intervals of 14 days from the 7th February, 1954. Effects of seasonal variation on the growth, development and first flowering of the crop were noted throughout the year. The trial of *H. cannabinus* was rejected due to a heavy attack of spiral borer, ring-pest and virus diseases at later stages of growth of the crop. From the results of the trial of *Hibiscus sabdariffa*, it was found that March 1st week sowing gave the highest plant height, base diameter and fibre yield as in the previous year. As regards fibre yield, however, there was no significant difference between the sowings from March to the end of April. March 1st week sowing gave significantly greater plant height, base diameter and higher yield of fibre than the February sowing. It is also interesting to note that, like last year, in all sowings after first week of March, fibre yield, plant height and base diameter progressively decreased.

(ii) *Seed-rate experiment with H. cannabinus.*—This experiment was repeated to determine the optimum seed-rate for Mesta with seed rates ranging from 5 lb. to 40 lb. per acre as in previous years. The results are given in Table XII.

TABLE XII

Seed-rate experiment with H. cannabinus.

Layout—Replicated randomized blocks in 5 replications.

Effective plot size—1/414 acre.

Date of sowing—7.5.54.

Date of harvest—11.9.54.

Seed-rate	Stand per acre	Av. height of plant (ft.)	Av. B.D. of plant (cm)	Green weight per acre (Md)	Fibre yield per acre (Md)
5 lb. per acre	40838	7.18	1.72	194.25	11.51
10 lb. „ „	55085	7.12	1.70	228.66	13.82
15 lb. „ „	65159	7.46	1.72	253.08	14.86
20 lb. „ „	78589	7.52	1.77	264.18	16.12
25 lb. „ „	82492	7.00	1.52	254.19	15.48
30 lb. „ „	83490	6.96	1.51	234.21	13.58
35 lb. „ „	84307	6.83	1.50	239.76	13.42
40 lb. „ „	89933	6.16	1.31	179.82	10.77
P	0.01	0.01	0.01	0.05	0.01
C.D.	26995	0.89	0.31	48.35	3.37
S.E.%	9.53	3.26	6.97	7.23	6.31

The differences with respect to stand per acre, average plant height, base-diameter and fibre yield were significant at 1 percent level whereas the difference with respect to green weight was significant at 5 percent level. The maximum fibre yield was obtained with 20 lb. seed-rate per acre, though it is statistically at par with other treatments ranging from 10 lb. to 35 lb. per acre. With the increase of seed rate upto 20 lb. there was a gradual increase in stand per acre with the corresponding increase in green weight and fibre yield. With further increase in seed-rate beyond 20 lb. per acre there is a general fall in the average base diameter, plant height, green weight and fibre yield inspite of the gradual increase in stand per acre.

(iii) *Seed-rate experiment with H. sabdariffa.*—This experiment was started in 1952-53 and was repeated. The results are given in Table XIII.

TABLE XIII.

Seed-rate experiment with H. sabdariffa

Layout—Replicated randomized blocks in 5 replications.

Effective plot size—1/150 acre.

Date of sowing—20.5.54

Date of harvest—8.12.54.

Seed-rate per acre.	Theoretical stand per acre	Actual stand per acre at harvest.	Mortality percentage	Av. height of plant (ft.)	Av. B.D. of plant (cm.)	Green weight per acre (Md.)	Fibre yield per acre (Md.)
5 lb.	102150	90801	11.11	10.31	1.70	384.86	21.33
10 lb.	204300	174170	14.75	9.35	1.22	406.77	22.40
15 lb.	306450	222754	27.31	8.10	1.09	417.55	23.29
20 lb.	408600	300823	26.38	6.72	0.88	391.17	20.86
25 lb.	510750	389736	23.69	6.52	0.83	397.11	20.23
30 lb.	612900	409717	33.15	6.42	0.83	380.77	19.71
35 lb.	715050	444533	37.83	6.09	0.75	384.11	18.82
40 lb.	817200	481238	41.11	5.24	0.64	350.68	18.44
P		0.01		0.01	0.01	large	0.01
C. D.		122481		2.26	0.49	—	3.51
S.E.%		9.53		7.87	12.72	5.22	4.35

Due to different seed-rates significant differences were obtained with respect to stand per acre, average plant height, base diameter of plants and fibre yield. A seed-rate of 15 lb. per acre gave the maximum yield of fibre though it was at par with other treatments ranging from 5 to 20 lb. per acre. The yield of fibre, however, decreased as the seed-rate increased beyond 15 lbs. per acre, lowest being at 40 lbs. seed-rate per acre. No significant difference was obtained between the different seed-rates with respect to green weight. With the increase in seed-rates, there was progressive decrease of plant height and base diameter. Mortality of plants increased with the gradual increase in seed rates:

(iv) *Spacing trial with H. sabdariffa var. altissima*.—This trial was conducted with 15 different combinations of spacings in lines and a usual broadcast method of sowing in replicated randomized blocks with 4 replications. The results are given in Table XIV

TABLE XIV.

Spacing trial with H. sabdariffa var. altissima.

Layout—Replicated randomized blocks with 4 replications.

Effective plot size—1/300 acre.

Date of sowing—24.5.54.

Date of harvest—2.12.54.

Spacing	Theoretical stand per acre	Actual stand per acre at harvest	Mortality percentage	Av. height of plants (ft.)	Av. B.D. of plants (cm.)	Fibre yield per acre (Mds.)
4" × 2"	784080	276243	64.77	6.60	0.92	26.22
4" × 4"	392040	210903	46.20	7.45	1.10	29.80
4" × 6"	261360	200884	23.14	7.74	1.16	30.79
6" × 2"	522720	252358	51.72	6.87	0.94	27.32
6" × 4"	261360	157832	39.61	7.95	1.12	30.97
6" × 6"	174240	140118	19.58	8.39	1.30	31.58
9" × 2"	348480	191374	45.08	8.22	1.18	29.47
9" × 4"	174240	132422	24.00	8.79	1.41	30.00
9" × 6"	116160	95033	18.19	9.08	1.47	33.88
12" × 2"	261360	131914	49.53	8.23	1.10	30.05
12" × 4"	130680	107738	17.56	8.72	1.30	31.70
12" × 6"	87120	86176	1.08	9.00	1.39	32.54
15" × 2"	209088	119862	42.67	9.20	1.40	28.62
15" × 4"	104544	80368	23.13	9.01	1.47	28.62
15" × 6"	69696	64178	9.92	10.33	1.70	29.58
Broadcast	363200	167098	53.99	7.19	0.99	24.58
P		0.01		0.01	0.01	0.01
C. D.		73840		1.64	0.35	5.15
S. E. %		12.86		5.18	7.43	4.55

The observed differences with regard to stand per acre, average plant height, base diameter and fibre yield due to different spacings both in and between the lines and broadcast sowings were significant at 1% level. It is also noted that the spacing 15" × 6" gave the highest plant height and base diameter. As regards fibre yield, however, the spacing 9" × 6" gave the highest fibre yield (33.88 maund per acre) and was significantly superior to the treatment broadcast which gave the lowest yield of fibre.

It is, however, interesting to note that for a particular spacing between the lines, the spacing of 6" within the line gave greater yield of fibre, plant height and base diameter than the spacings of 2" and 4" within the line. It is also observed that with the increase in the spacing within the line the average height, base diameter of plants and fibre yield generally increased while the mortality of plants decreased.

(v) *Manurial trial with Hibiscus sabdariffa*.—A manurial trial was conducted in replicated randomized blocks with 4 replications to study the effect of N, P, K (applied singly and in combinations) and compost (at 20 lb. and 40 lb. of N per acre) on the yield and quality of fibre. The test was insignificant. Fibre samples have been sent to Technological Research Laboratories for quality test.

(vi) *Combined yield trial of different fibre crops*.—A combined yield trial with Mesta, roselle, sunnhemp, *Malachra* and jute was repeated in replicated randomized blocks with 4 replications. Both roselle G.P. and roselle green gave significantly higher yield of fibre than all the fibre crops included in this trial at 1% level. Between roselle G.P. and roselle green, however, there was no significant difference though G.P. gave higher yield of fibre (30.16 maund per acre). Sunnhemp and *Malachra* gave significantly lower yield of fibre than jute (D154 and C.G.) and mesta (Laplantation).

III. ANATOMY AND CYTOGENETICS.

STUDY OF DISTINGUISHING FEATURES OF FIBRE BUNDLES IN SUBSTITUTE FIBRES AND CHARACTERISTICS OF ULTIMATE FIBRE CELLS.

(i) *Sulphuric acid treatment*.—On treatment of fibre samples of mesta, roselle, *Sida*, *Urena*, *Abutilon* and *Abroma* with 60, 65, 70 and 75 percent sulphuric acid, all samples dissolved readily except in 60 percent in which the action was slow and gradual. In all cases the dissolution was associated with brown coloration, the intensity of which was not constant in different samples.

(ii) *Chemical sectioning*.—To study the number of layers of the secondary wall of ultimate fibre cells of mesta and roselle fibres chemical sectioning was done. In both the cases the sections showed 20—30 layers as in the case of jute.

Leaf and fibre Development in Sisal.—Shoot tips of *Agave sisalana* and *Agave cantala*, grown at Nilganj farm, were fixed for the study of the development of leaves. For the study of the origin and development of fibres young leaf bases which form the growing zone of the leaf were fixed during active growth of the plant. The work is in progress.

Number of fibre bundles per unit area of leaf in Agave sp.—This study was undertaken to find out the differences in the fibre content of the different species of *Agave*. Transverse sections were cut from the base of the different leaf samples. Bundles were counted from different parts of the sections under the microscope. Ten readings from each section were taken and average number of bundles per square mm. of the sections (leaf) in each case was worked out as shown below:—

<i>Agave cantala</i>	—	Bombay collection	—	3.80
		Nilganj	„	2.65
<i>Agave sisalana</i>	—	Bombay collection	—	1.50
		Nilganj	„	1.50
<i>Agave veracruz</i>	—	Panagarh	„	1.60
		Nilganj	„	1.50
<i>Agave wightii</i>		Bombay	„	2.1

It is seen that *Agave cantala* has the largest number of fibre bundles in an unit area and is easily distinguished from the rest by the bundle count.

For the study of comparative bundle number per unit area, 5 leaves of different lengths each of *A. cantala* and *A. sisalana* were brought from Gobindapur farm, Sambalpur. From each leaf 9 transverse sections were cut, 3 each (1 inch apart) from top, middle and base. Readings from each section were taken in three regions separately viz., centre intermediate and marginal portions of the transverse section, covering the whole area from upper to lower epidermis in a vertical strip in each case. From these readings, bundles per square mm. were calculated. Readings of 'top' sections were rejected because the area of those sections were too small to be divided into three distinct regions.

Analysis of the results showed that the difference of the average number of bundles in the basal region (*A. sisalana*—2.03, *A. cantala*—2.44) of the leaves of the two species was more pronounced than that of the 'middle'—(*A. sisalana*—1.72, *A. cantala*—1.62). It is evident in either case that there is no correlation between the length of the leaf and the number of bundles per unit area. In the base of the leaf, in either case, it was seen that the density of bundles at the 'centre' region was minimum and it gradually increased towards the 'margin'. This was observed, without any exception, in all the leaves individually at the base. But no such correlation existed in the 'middle' sections of either species. Further, it was seen that the average number of bundles at centre, intermediate and 'margin' regions of *A. sisalana* were quite distinct from the corresponding regions of *A. cantala*. Thus the average number of bundles per unit area of the transverse section, as a whole or as a part, at the basal portion of the leaves of *A. sisalana* and *A. cantala* may be utilised for the identification of these two leaves.

Length and breadth of ultimate fibre cells of Agave species.—(a) Comparative study of the length and breadth of the ultimate fibres of different species of *Agave* was undertaken

to see the specific difference, if any. The following gives the gist of the average length and breadth of ultimate fibres from top, middle and base of the leaves.

	Length	Breadth
<i>A. sisalana</i> —Nilganj collection	1.763 mm.	25.48 μ
Bombay „ „	1.960 „	24.48 „
<i>A. cantala</i> —Nilganj „ „	2.210 „	23.71 „
Bombay „ „	2.192 „	25.16 „
<i>A. veracruz</i> —Nilganj „ „	0.844 „	18.86 „
Panagarh „ „	2.053 „	31.88 „
<i>A. wightii</i> —Bombay „ „	1.727 „	24.92 „

From the above it is seen that *A. cantala* has the longest ultimate fibres among the species studied. Excepting *A. veracruz*, there is not much difference in the breadth of the ultimate fibres. *A. veracruz* sample of Nilganj Farm shows maximum reduction in length and breadth of the ultimate fibres and it is quite distinct from the rest of the samples studied. *A. veracruz* (?) from Panagarh has the maximum width (31.88 μ) which is quite distinct from others.

Similar study was undertaken with two samples of *Agave*, *A. cantala* and *A. sisalana* received from Gobindapur Farm, Sambalpur. Ultimate fibres from base, middle and top of 5 leaves of each of the species were being studied.

2. Cytological studies

Further fixation of pistils at different intervals after pollination in some of the new interspecific crosses attempted during the year was done to study the pollen-tube growth in these crosses. Pollen fertility counts in different types of *H. cannabinus* (both foreign and indigenous), *H. radiatus*, *H. panduraeformis*, *H. suratensis*, *H. lunarifolius* were in progress.

Flower buds of *H. radiatus*, *H. cannabinus* and of the F_1 crosses of *H. radiatus* X *H. cannabinus* were fixed. The cytological analysis of these F_1 hybrids was in progress.

Treatment of a large number of crossed seeds of *H. radiatus* × *H. cannabinus* with different timings and concentrations of colchicine solution was also done. Records on germination count and other morphological characters in these colchicine treated plants were taken. Seeds from 9 of these colchicine treated plants were carried forward.

IV. DISEASE.

Hibiscus cannabinus.—(a) Virus A and virus B.—Routine observations of incidence of the two diseases were recorded. Selected materials were brought forward.

(b) *Root-rot of Mesta*.—Inoculation tests showed that *Rhizoctonia* isolated from mesta infected jute and *vice-versa*.

(c) *Brown-rot*.—Due to mixed infection of *Volutella* and *Cercospora* the study was abandoned.

Sunn-hemp.—Heavy wilt was observed in most of the selections. There has been no wilt so far in the other species of *Crotalaria*.

Roselle.—Records from a manurial trial show that the differences in the incidence of *Phoma sabdariffa* were insignificant.

Ramie.—Heavy incidence of *Alternaria* and *Curvularia* Sp in leaves of ramie was noted. The blight was widespread. The two pathogens were isolated and are being maintained for future pathogenicity tests.

V. PESTS.

Agrilus acutus.—The insect has gradually established itself as a major pest of *H. cannabinus*.

Preliminary observations on some of the aspects of the biology of the pest were taken. The females prefers the nodal joints as the site for laying egg. The larva on hatching bores inside the stem and travels spirally throughout the entire length of the stem. No influence of geotropism has been observed on

the larva. Difficulties were encountered in rearing the larvae under laboratory conditions. Observations on the stage of the larva responsible for inducing development of the gall on the stem were in progress.

Effect of different dates of sowing on the incidence of the pest.—Monthly observations were made from the two different dates of sowing trials with *Hibiscus cannabinus* and *H. sabdariffa* as host materials. There were altogether 14 treatments, sowing being done at interval of about a fortnight beginning from 17th February and ending on the 18th August.

In case of *H. cannabinus*, it has been observed that the crops sown during second half of April and first half of May were attacked significantly more than crops sown on other dates. Crops sown before the middle of March showed no incidence. *H. sabdariffa* which had a longer vegetative period, showed higher incidence during the period when *H. cannabinus* attained its harvest stage. Incidence was much less in *sabdariffa* than in *cannabinus*. But the trend of incidence of attack on *sabdariffa* with reference to sowing dates was more or less similar to that of *cannabinus*.

Varietal difference on incidence.—Records were taken from the two varietal trials (*H. cannabinus* and *H. sabdariffa*) on the incidence of the pest to determine the varietal resistance, if any, amongst the varieties. All the four varieties of *cannabinus* were susceptible and the differences amongst them were insignificant.

Incidence was much less in all the varieties of *sabdariffa* than *cannabinus*. No significant difference on incidence was obtained amongst the varieties.

B. Transmission of mesta virus.—It is necessary to test whether the disease is transmitted through seeds or not, as otherwise, insect transmission tests may become misleading. Accordingly, test on seed transmission was also carried out.

(i) *Seed transmission.*—Selections made in the previous year from the two types of virus infected and apparently healthy plants were sown and records were maintained on the appearance

of symptoms of virus on the progenies. The progenies were kept free from insect attack by frequent application of insecticides. It was observed that very few plants amongst the progenies were virus-affected suggesting that the virus is probably not 'seed' transmitted.

(ii) *Insect transmission*.—Limited number of insect transmission tests could be carried out for want of facilities. *Empoasca devastans* and white flies were used as test insects. Results were, however, inconclusive. Further work will be continued.

XI. WORK ON EXTENSION OF IMPROVED METHODS OF JUTE CULTIVATION.

The purpose of the scheme is to popularise with the growers the results of researches carried out at the Jute Agricultural Research Institute through demonstrations and to extend the area under the improved methods of jute cultivation. The scheme was taken up at 3 centres, Barrackpore, Baraset and Basirhat in the district of 24-Parganas. The following recommended methods were adopted :—

- (i) Use of seeds of improved varieties.
- (ii) Sowing in lines by seed-drill.
- (iii) Interculture and weeding by wheel hoes.
- (iv) Judicious application of organic manures and fertilizers.
- (v) Adoption of plant protection measures to control pests and diseases.
- (vi) Use of improved technique of retting and extraction of fibre.

Besides these, double and triple-cropping practices were encouraged in suitable areas.

The demonstration plots were confined to 10 acres of land at each centre. The size of the plots were about $\frac{1}{3}$ acre each and they were distributed within a radius of 5 miles from each centre. The programme was as follows : (a) 3 acres of low land for double cropping with *capsularis* Jute and *aman* paddy. (b) 4 acres of medium land—2 acres each with *capsularis* and *olitorius jute*—triple -cropped with jute, paddy and pulses, and (c) 3 acres of high land—double cropped with *olitorius jute* and pulses, or any rabi crop.

The target of 30 acres for 3 centres was, exceeded by 6 acres.

The Baraset Extension centre was under the charge of a fieldman, but the Basirhat centre continued to be under a Fieldman transferred temporarily from the Institute. The

Barrackpore centre was under the direct supervision of the Farm Manager. The Agronomist was in charge of the scheme till the Extension Agronomist joined on the 6th November, 1954.

Sowing of 86 plots was completed in cultivators' fields covering an area of 36 acres out of which 11 plots measuring approximately 3 acres failed due to various reasons and 75 trials were successfully conducted. The cost of cultivation, net profit from jute, paddy and pulses are given in Table XV.

The cultivators in all the 3 existing centres at Barrackpore, Baraset and Basirhat were impressed by the effectiveness of the improved methods of jute cultivation. The actual increased demands on the part of the cultivators for improved jute seed, seed-drills, and pushed wheel hoes, fertilizers and insecticides show that they were convinced of the reduced cost of cultivation and the extra profit derived from the higher yield and better quality of jute by practicing improved methods.

FARMERS' WEEK AND JUTE EXHIBITION

Farmers' week was observed and an exhibition was organised in September, 1954 at the farm of the Jute Agricultural Research Institute with the object of maintaining contact with the cultivators with regard to their problems on jute cultivation as well as to acquaint them with the improved methods. During the week, discussions on all aspects of jute cultivation were arranged, use of seed drills, hand hoes and plant protection machineries was demonstrated and proper method of retting, extraction and grading was explained to the jute growers. The exhibition was both interesting and instructive. Cultivators in large numbers attended not only from villages near about the Research Station but also from distant areas and evinced keen interest.

Enquiry into cost of cultivation of jute.

A preliminary enquiry for the study of the cost of cultivation of jute crop was undertaken in the three centres under the Extension work viz. Nilganj, Basirhat and Baraset. The scope

TABLE XV.
Showing the cost of cultivation, net profit from jute, paddy and pulses per acre.

Details.	Nilganj Centre		Baraset Centre		Basirhat Centre		Average of 3 Centres.	
	Improved method	Traditional method	Improved method	Traditional method	Improved method	Traditional method	Improved method	Traditional method
<i>1st Crop—Jute</i>								
1. Average cost of cultivation (Rs.)	234-11-0	314-15-0	233-1-0	264-4-0	199-2-0	236-8-0	222-4-9	271-14-3
2. Yield (Md)	18-0-0	17-0-0	21-34-8	18-0-0	18-18-0	17-0-0	19-17-8	17-13-5
3. Average price of fibre per Md (Rs.)	22-10-0	22-10-0	23-0-0	23-0-0	21-11-0	21-11-0	22-7-0	22-7-0
4. Price of produce—fibre and stick (Rs.)	437-4-0	410-10-0	502-13-0	414-0-0	336-0-6	361-0-0	442-0-6	385-3-3
5. Net profit (Rs.)	202-9-0	95-11-0	269-12-0	149-12-0	186-14-6	124-8-0	219-11-9	123-5-0
<i>2nd Crop—Paddy</i>								
1. Average cost of cultivation (Rs.)	97-7-0	80-13-0	80-13-0	71-12-0	71-12-0	71-12-0	83-5-3	83-5-3
2. Yield (Md)	15-0-0	12-12-0	12-12-0	19-26-0	19-26-0	19-26-0	15-26-0	15-26-0
3. Price of produce (Rs.)	150-0-0	129-12-0	129-12-0	196-4-0	196-4-0	196-4-0	158-10-6	158-10-6
4. Net profit (Rs.)	52-9-0	48-15-0	48-15-0	124-8-0	124-8-0	124-8-0	75-5-3	75-5-3
<i>Pulses</i>								
1. Average cost of cultivation (Rs.)	43-10-0	42-3-0	42-3-0	45-0-0	45-0-0	45-0-0	43-9-9	43-9-9
2. Yield (Md)	9-0-0	7-38-0	7-38-0	10-11-0	10-11-0	10-11-0	9-3-0	9-3-0
3. Price of produce (Rs.)	90-0-0	79-5-0	79-5-0	123-3-0	123-3-0	123-3-0	97-8-0	97-8-0
4. Net profit (Rs.)	46-6-0	37-2-0	37-2-0	78-3-0	78-3-0	78-3-0	53-14-3	53-14-3

of the enquiry was limited within the jute growers only. From the observations taken by the Field staff during and after the jute season, detailed informations were collected and the variations in the cost of cultivation of jute crop were studied.

The man-days employed for different operational stages were worked out and the percentages of the total human labour employed per acre for the operations, viz., ploughing-laddering, manuring, sowing, raking, weeding-thinning, harvesting, steeping, washing-stripping and drying-bundling were calculated to be as 14.8, 3.1, 1.3, 0.7, 24.4, 12.3, 12.1, 24.0 and 7.3 respectively. The maximum labour was employed in weeding-thinning and washing-stripping operations. Wherever wheel-hoe was used, operational cost was reduced to some extent. It was noted that the human labour took nearly 69%, cattle labour 17%, seed 5% and manure 9% of the total operational cost respectively. The average total cost per acre for the cultivation of jute crop in the area under investigation varied from Rs. 204/- to Rs. 272/-.

The enquiry was also made to estimate the average cost of production of the main food crop viz., paddy. The net profit from the cultivation of jute was much more than that from paddy.

PRODUCTION OF IMPROVED SEEDS AT THE JUTE AGRICULTURAL RESEARCH INSTITUTE FARM

The improved seeds have already earned popularity in the important jute growing centres and demand for improved seeds of different varieties has increased. With a view to meet the minimum demand of nucleus seeds required by the State Agricultural Departments and experimental requirements a total quantity of about 64 maunds of *capsularis* and *olitorius* seeds were produced.

Due to shortage of cultivable land at the farm at Nilganj it was not possible to multiply more seeds. Only about 11 acres were covered by seed crop. Seeds were also obtained by

harvesting the non-experimental borders and crop not required for fibre. The names of the varieties and the quantities of seed produced are shown below.

<i>Variety</i>	<i>Average</i>	<i>Yield in Md.</i>	<i>Yield from non-experimental border, etc.</i>
JRO-632	3.86	12-17-0	5-28-0
JRO-753	1.14	4- 2-0	—
JRO-620	0.55	2- 2-0	—
C.G.	0.67	3-13-0	—
R-26	0.05	0- 8-0	0-27-0
Total <i>Olitorius</i>	6.27	22- 2-0	6-15-0
JRC-321	0.92	4-39-0	—
JRC-412	0.41	0-31-0	—
JRC-1	0.50	1-30-8	—
JRC-212	2.19	10-34-0	6-16-0
Fanduk	0.41	1-10-0	—
D154	0.40	2-18-0	5-17-0
JRC-918	0.46	0-29-8	—
JRC-919	0.21	0-17-8	—
Total <i>capsularis</i>	5.50	23- 9-8	11-33-0

After meeting the requirements of the Institute, the seeds were mainly distributed to the different jute growing States for experimental purposes and for multiplication.

LIBRARY.

The library is subscribing most of the important and useful journals on agriculture and allied subjects. Accession to the library has also increased quite satisfactorily by additions of recent publications. The library is intensively used by the members of the Institute, scientific workers engaged in the various sections of the Indian Central Jute Committee and also research workers from the different scientific institutions of Calcutta and other places.—Evidence of the increasing use made of the library is provided by the fact that the number of loans in the year under review was 1260 as against 1070, last year.

173 books, 112 journals and other Government and semi-government publications were added to the library during the year under report, thus making about 3,836 volumes in the library. The author catalogue of books has been made up to date and other forms of catalogue will also be undertaken when necessary staff for the library will be provided for.

MISCELLANEOUS.

Enquiries.—During the year under report a number of enquiries relating to jute and substitute fibre crops were received for comments from the Government of India and other Indian and foreign sources and suitable notes in reply were prepared and communicated.

Changes in the staff.—The following appointments were made during the period. Dr. M. K. Mukherjee, Assistant Chemist was appointed as Chemist on 20th November, 1954. Shri B. K. Das, Agronomical Assistant was appointed Assistant Agronomist on 20th November 1954. The following were also appointed :—

Shri K. L. Gurnani—Extension Agronomist	6-11.54.
Shri N. C. Giri—Statistical Assistant—	28.9.54.

The following members of the staff have resigned : Shri S. D. Mitra, Entomological Assistant (6.7.54). Shri P. M. Naha, Junior Mycological Assistant (1.10.54) and Shri S. K. Majumder, Physiological Assistant (28.12.54).

Visitors.—During the year under report a large number of visitors visited the Institute and showed keen interest in the general activities of the Institute and expressed great satisfaction about its achievements. Amongst them the names of the following distinguished persons may be mentioned.

1. Shri K. R. Damle, I.C.S., *President*, Indian Central Jute Committee.
2. Shri Basanta Kumar Das, M.P., *Member*, Indian Central Jute Committee.

3. Shri K. M. Das, *Member*, Indian Central Jute Committee.
4. Shri L. Singhanian, *Member*, Indian Central Jute Committee.
5. Dr. W. B. Arnim, German Embassy, New Delhi.
6. Mr. C. E. Iverson, Agrostologist, Canterbury Agricultural College, University of New Zealand.
7. Mr. John Donald Black, Harvard University, U.S.A.
8. Mr. N. L. Stewart, U.S. Department of Agriculture, Washington.
9. Dr. T. S. Robertson, Chief, Fibres Section, F.A.O.
10. Dr. R. H. Kirby, Fibre Expert, Colonial Products Laboratory, London.
11. Shri J. V. A. Nehemiah, *Secretary*, Indian Council of Agricultural Research, New Delhi.
12. Shri M. B. Ghatge, Agricultural Marketing Adviser to the Government of India, New Delhi.
13. Shri V. S. Tilak, Director of Agriculture, Orissa.
14. Shri V. M. Srikumaran Nayar, Deputy Chief Controller of Exports, New Delhi.
15. Shri S. Majid, Director of Agriculture, Assam.
16. Mr. Mus Jung, Dy. Agricultural Commissioner with the Government of India, New Delhi.
17. Shri G. L. Puri, Consul Designate, Muscat.
18. Shri J. Singh, Ministry of Commerce and Industries, Government of India, New Delhi.
19. Shri R. Venkateswaran, Indian Foreign Service.
20. Shri Bimalendu Kumar Sanyal, Indian Foreign Service.

21. Shri K. S. Bajpai, Ministry of External Affairs, New Delhi.
22. Mr. J. C. Abraham, Ministry of External Affairs, New Delhi.
23. Shri A. P. Venkatswaran, Ministry of External Affairs, New Delhi.
24. Shri J. C. Ajmani, Ministry of External Affairs, New Delhi.
25. Shri D. S. Kamatkar, Ministry of External Affairs, New Delhi.
26. Shri S. Singha, Ministry of Commerce and Industries, New Delhi.
27. Shri B. Sitaraman, Economic Adviser, Ministry of Commerce and Industries, New Delhi.
28. Shri R. K. Baltir, Ministry of Commerce and Industries, Government of India, New Delhi.

ACKNOWLEDGMENT.

I take this opportunity of expressing my sincere thanks to the members of the staff of the Jute Agricultural Research Institute for the ungrudging help and co-operation rendered by them in the successful implementation of the various types of work carried out in this Institute.

B. C. KUNDU,

*Director, Jute Agricultural
Research Institute.*

PUBLICATIONS

The following is a list of papers published or sent for publication during the year :—

1. Das Gupta, B. & Sarma, M.S.—Two sterile mutations of *C. capsularis*, Heredity (in press).
2. Datta, A. N., Sanyal, P. & Kundu, B. C.—Effect of row-cropping in Roselle (in press).
3. Datta, A. N. Sanyal P. & Kundu, B. C.—Preliminary studies on the effect of different dates of sowing in mesta and roselle. Proc. Indian Science Congress, III, 1955.
4. Datta, N.—Diapause in *Nupserha bicolor* Thoms. ssp. *Postbrunnea* Breun and its bearing on infestation and control. Jute Bulletin September, 1954.
5. Datta, R. M.—Pollen grain morphology of the genus *Corchorus*. (Sent to New Phytologist).
6. Datta, R. M.—Cytomorphological studies of the pollen tubes of jute species. (Sent to Caryologia).
7. Datta, R. M.—Male gametophyte in cultivated jute. Current Science, 1954.
8. Datta, R. M. & Patel, G. I.—Cytogenetical investigations of X-ray induced mutation in jute (*C. olitorius* L.) Proc. Indian Science Congress, III, 1955.
9. Ghosh, T. & Das, B. K.—Farmers' week at Nilganj. Jute Bulletin. Sept., 1954.
10. Kar, B. K. & De Sarkar, B. K.—Dual purpose of growing jute for fibre and seeds. Proc. Indian Science Congress, III, 1955.
11. Kar, B. K. & Mazumdar, S. K.—Growth sequence in relation to stalk and foliage in jute. Proc. Indian Science Congress, III, 1955.

12. Kar, B. K. & Mazumdar, S. K.—Some growth characteristics of jute. Textile India, 1954.
13. Kundu, A. K. Halder, G.—A note on the biochemical changes during retting of jute. Proc. Indian Science Congress. III, 1955.
14. Kundu, B. C.—Manuring of Jute, Agriculture Bulletin, I.C.J.C., 1954.
15. Kundu, B. C.—Influence of retting on the quality of jute. Textile India, 1954.
16. Kundu, B. C.—Improving the quality and production of jute. The Statesman. 14-12-54.
17. Kundu, B. C.—Jute—our wealth. Indian Youth, Special number, 1954.
18. Kundu, B. C.—Jute, the most important bast fibre plant. Economic Botany. (In press).
19. Kundu, B. C. & Sarma, M. S.—Jute seed. I. Nature and Characteristics. Jute Bulletin. Feb., 1955. Agri. Res. Bulletin, No. 3.
20. Kundu, B. C. & Sarma, M. S.—Jute seed II. Production and distribution of improved varieties. Jute Bulletin, March, 1955.
21. Kundu, B. C., Das, B. K. & Dua, D.B.—Adopt line sowing for higher profits. Indian Farming. (In Press).
21. Kundu, B. C. & Rao, N. S.—Origin and development of axillary buds in *Hibiscus cannabinus*. Proc. Indian Science Congress, 1955. American Journal of Botany (in press).
23. Kundu, B. C., Mukherjee, M. K. & Halder, G.—A short note on the growth of jute (*C. capsularis*—D154) with fertilizers under water-logged conditions. Proc. Indian Science Congress. III, 1955.

24. Kundu, B. C., Kundu, A. K. & Halder, G.—Retting of jute III. Shortening of retting period by means of chemical activators. Proc. Indian Science Congress. III, 1955.
25. Kundu, B. C., Datta, A. N. & Sanyal, P.—Comparative study on the yield performances of different fibre crops. Proc. Indian Science Congress. III, 1955.
26. Mukherjee, M. K. & Chakrabarty, S. C.—Exhaustion of the soil and uptake of nutrients by different varieties of jute grown under the same conditions. Proc. Indian Science Congress. III, 1955.
27. Mukherjee, M. K., Chakrabarty, S. C., Kundu, A. K. & Halder, G.—Jute leaves as manures I: Influence on the growth of paddy. Proc. Indian Science Congress. III, 1955.
28. Mukherjee, M. K., Chakrabarty, S. C., Kundu, A. K. & Halder, G.—Jute and soil fertility I: Nitrogen problem. Proc. National Academy of Sciences (India) (in press).
29. Mukherjee, M. K., Chakrabarty, S. C., Kundu, A. K. & Halder, G.—Jute and soil fertility II: Phosphate problems. Proc. National Academy of Sciences (India) (in press).
30. Mukherjee, M. K. & Kundu, A. K.—A new method of retting of jute in stacks. Science and Culture. Vol. 20. No. 8, p. 406.
31. Rao, N. S. & Kundu, B. C.—The effect of maturity on the dimensions of ultimate fibres of jute. Jour. Scientific & Industrial Research, March, 1955.
32. Rao N. S., Kundu, B. C. & Saha, S. B.—Ultimate fibres and quality in jute. Jour. Scientific & Industrial Research (in press).
33. Sen, S. N.—“Study of Estimation of Soil Heterogeneity”—Proc. Ind. Science Congress, III, 1955.

STAFF

A list of the staff is given below :—

1. Director ... Dr. B. C. Kundu, M.A., Ph.D.
(Leeds), F.L.S., F.N.I.
2. Technical Assistant to
Director ... Vacant.

Agronomical Section

1. Agronomist ... Vacant.
2. Assistant Agronomist ... Sri B. K. Das, B.Sc. (Ag.),
(Remained in-charge of the
Section during the period
under report).
3. Senior Assistant ... Vacant.
4. Assistant ... Sri D. B. Dua, B.Sc. (Ag.).
5. —do— ... Vacant.

Botanical Section

1. Botanist ... Sri B. Das Gupta, M.Sc.
2. Assistant Botanist ... Sri B. Roy, M.Sc. (Cal.), M.Sc.
(Lond.).
3. Senior Assistant ... Vacant.
4. Assistant ... Sri M. S. Sarma, M.Sc.
5. —do— ... Sri K. L. Ghosh, B.Sc., B.Ag.
6. Herbarium Assistant ... Vacant.

Cytogenetical Section

1. Cytogeneticist ... Dr. G. I. Patel, B.Sc. (Ag.),
M.S., Ph.D. (California).
2. Assistant ... Sri R. M. Dutt, M.Sc.

Anatomical Section

1. Senior Anatomical
Assistant ... Vacant.
2. Anatomical Assistant
(In charge) ... Sri N. S. Rao, M.Sc. (Ag.).

3. Assistant ... Dr. A. K. Datta, M.Sc., D.Phil.
(Cal.).
4. Junior Assistant ... Sri S. B. Saha, B.Sc.

Physiological Section

1. Physiologist ... Dr. B. K. Kar, M.Sc., Ph.D.
(Leipzig).
2. Assistant ... Sri S. K. Mazumdar, M.Sc.
(since resigned).
3. Junior Assistant ... Sri B. K. De Sarkar, B.Sc.

Chemistry Section

1. Chemist ... Dr. M. K. Mukherjee, M.Sc.,
Ph.D. (Dacca).
2. Assistant Chemist ... Vacant.
3. Senior Assistant ... "
4. Microbiological Assistant Sri A. K. Kundu, M.Sc.
5. Chemical Assistant ... Sri S. C. Chakravorty, M.Sc.
6. Biochemical Assistant ... Sri G. S. Halder, B. Sc.
(Officiating).
7. Junior Chemical Assistant Vacant.
8. —do— ... Vacant.

Mycological Section

1. Assistant Mycologist ... Sri T. Ghosh, M.Sc.
2. Senior Assistant ... Vacant.
3. Assistant ... Sri M. Basak, B.Sc.
4. Junior Assistant ... Vacant.

Entomological Section

1. Assistant Entomologist Sri N. Dutt, M.Sc.
2. Senior Assistant ... Vacant.
3. Assistant ... Sri R. N. Ganguli, M.Sc.
4. Junior Assistant ... Sri S. P. Bhattacharjee, B.Sc.

Substitute Fibre Section

1. Assistant Botanist ... Vacant.
2. Assistant ... Sri P. Sanyal, M.Sc., Assoc.,
I.A.R.I. (Remained in
charge of the Section during
the period under report).
3. —do— ... Sri A. N. Dutta, B.Ag.

Extension Section

1. Extension Agronomist ... Sri K. L. Gurnani, B.Ag., M.S.
(Texas) Assoc. I.A.R.I.
2. Assistant ... Sri S. K. Majumdar, B.Sc.
(Ag.).
3. —do— ... Vacant.
4. —do— ... Vacant.

Statistical Section

1. Statistician ... Sri S. N. Sen, M.Sc.
2. Assistant ... Sri N. C. Giri, M.Sc.

Library

1. Librarian ... Sri A. K. Sur, M.Sc. Dip. Lib.
2. Assistant Librarian ... Vacant.

Farm

1. Farm Manager ... Sri P. K. Das, B.Sc., B.Ag.

Office

1. Head Clerk ... Sri R. Chakravorty, B.A.
2. Artist ... Sri T. D. Nag, B.A.

APPENDIX

Programme of work as sanctioned	Progress of work in 1954-55	Future programme of work in 1955-56
I. Breeding and Genetics of jute 1. Collection of varieties and types including wild species of <i>Corchorus</i>. 2. Breeding of improved strains of jute.	86 indigenous and 12 exotic samples of seeds were grown and studied. Of the promising materials 164 selections were carried forward. Eight progeny row trials, five <i>capsularis</i> and three <i>olitorius</i> including one trial of X-irradiated materials were carried out. 4252 secondary selections were made in these trials. Two varietal trials, one <i>capsularis</i> and one <i>olitorius</i> were conducted. Among the <i>capsularis</i> strains JRC-919 gave 20 per cent higher yield than D154 (control) and JRC-212 yielded about three per cent higher, though it was statistically as good. The early variety JRC-321 maintained its high quality ratio. Among the <i>olitorius</i> strains, JRO-753, JRO-632 and JRO-620 proved significantly superior to the control C.G. yielding about 30, 25 and 18 per cent higher respectively.	To be continued. To be continued

Varietal trials in State farms.—12 varietal trials were allotted to the five jute growing States, two, each of *capsularis* and *olitorius* in W. Bengal and one of each in Bihar, Assam, Orissa and U.P. Except the *olitorius* trial allotted at Chinsurah Farm, West Bengal, the rest of the 11 were sown. One additional *capsularis* trial was sown in Ghograhat farm, U.P. under low-land conditions. Of these, 4 *capsularis* trials, two in West Bengal and one each in Orissa and U.P. and one *olitorius* trial in Assam besides the *capsularis* low-land trial at Ghograhat, U.P. were successful. The rest of the trials failed due to various reasons. In the *capsularis* trial at Cooch Behar, West Bengal, JRC-321 and JRC-1 proved significantly superior to the early type Fanduk (control) though both were statistically as good as the late type D154 (control). In the varietal trial at Ghograhat, U.P., the yield of the different varieties were statistically insignificant and in the low-land trial Fanduk, D154, JRC-212 and JRC-321 were statistically as good but significantly superior to local and JRC-412. In the only successful *olitorius* trial at Dalgaoon, Assam, JRO-632 proved significantly superior to the control C.G. yielding about 22% higher.

To be continued.

Subvention trials in cultivators' plots.

Of the 85 trials planned, 84 were sown. 20 *capsularis* and 19 *olitorius* trials were success-

Programme of work as sanctioned	Progress of work in 1954-55	Future programme of work in 1955-56
Polyploidy.	ful. JRC-1 and JRC-212 in U.P. and JRC-1 in Bihar proved significantly superior to the 'locals' yielding 30, 25 and 18 per cent higher respectively. Of the <i>olitarius</i> strains, JRO-632, JRO-753 and JRO-620 proved significantly superior to the 'locals' in West Bengal yielding about 30, 27 and 20 per cent higher respectively. Germination in the <i>capsularis</i> polyploids of the 1950 colchicine treated series was very poor. The plants maintained the characteristics of the polyploids. Seeds were collected from 11 selected plants. Germination in <i>olitarius</i> tetraploids grown was good in most cases. Seeds were collected from 31 selected plants.	To be continued.
Studies on irradiation with X-rays.	X3 generation : Out of 17 <i>capsularis</i> and 10 <i>olitarius</i> selections sown, 10 <i>capsularis</i> and 9 <i>olitarius</i> selections gave only normal progenies. 4 <i>capsularis</i> selections segregated giving plants with irregularly serrated wavy leaves	To be continued.

and normals and three selections segregated giving sterile, narrow-leaved individuals and normals. A single pod from one of the *olitorius* selections gave late maturing sterile plants with short internodes and narrow-leaves.

X2 generation : 34 *capsularis* and 10 *olitorius* aberrant selections were grown of which 31 *capsularis* and 9 *olitorius* proved to be normal and the rest segregated. Bifurcation of the stem was found to be a non-heritable character.

To be continued.

Vegetative rapprochement as a means of overcoming interspecific cross incompatibility in jute.

Seeds from stocks and scions of two fourth-generation-grafts obtained last year were sown. 15 fresh grafts were successful and seeds of both stocks and scions were collected from them. Of the 13 interspecific crosses made, 11 developed into pods but none gave viable seeds.

To be continued.

3. Inheritance of character.
Genetic strains.

88 selections from true breeding cultures were grown and 480 selections were made in these cultures. Seeds of *Corchorus depressus* failed to germinate.

77 selections were grown in the purification series and 10 cultures were found to be true breeding. 302 selections were made.

To be continued.

Isolation of full green genotypes.

47 test crosses along with 23 parental selections were grown. 11 parents belonging to

Programme of work as sanctioned	Progress of work in 1954-55	Future programme of work in 1955-56
Leaf variants.	the heterozygous plots of previous year segregated fresh crosses were made to confirm the known genotypes and to isolate some fresh genotypes. <i>capsularis</i>.—Deeply serrated, female sterile type: 8 out of the 10 normal selections from the heterozygous plots of previous year segregated. 46 selections of normal plants were made in the segregating families. <i>Crumpled leaf type</i>.—The F₁'s of crosses with normal were like normal. The full green genotype of the variant was found to be similar to that of JRC-212 in a plot of which it was first detected. 18 back crosses, six F₂'s and parents were carried forward. <i>Olitorius crumpled leaf type</i>.—A variant with crumpled leaf was noticed in a type plot of cultivators' materials grown during 1954 season and was crossed to dark red and green <i>olitorius</i>. The crosses and parents were carried forward.	To be continued. To be continued. To be continued.
Leaf-shape and size in <i>C. capsularis</i>.	Nine F₁ selections, 31 back crosses and 7 parents covering broad, normal and narrow	Completed.

leaf types were grown and the leaves of F2, back cross and parental families were measured.

Plant height.

To be continued.

17 back crosses, three F1 selections and two parents of *capsularis* and eight back crosses, three F1 selections, four fresh crosses and five parents of *olitorius* were grown. Germination of back crosses and F1 selections was poor.

Back crosses, some fresh crosses, F1 selections and parents were carried forward.

Earliness in *C. capsularis*.

To be continued.

The back-crosses, F1 selections of Maniksari X D154 and parents and 47 crosses made last year were grown. The F1s were back crossed to the respective parents. 385 selections were made in the F1, F2 and parental families.

II. Anatomy

1. Structure and quality of fibre.

To be continued.

From a study of the relationship of ultimate fibre and quality of jute from yarns tested for their quality it has been observed that long and slender ultimate fibres are associated with good quality.

The length of the ultimate fibres in all important varieties will be measured.

2. The effect of fertilizers on the formation and development of fibre.

The size of the fibre bundle, the number of ultimate fibre in cross-section of fibre bundle, and the dimensions of ultimate fibres will be measured.

The number of fibre bundles in fibre wedge, the total number of fibre bundles in the entire section and the number of layers were counted in plants to determine the effects of nitrogen (from ammonium sulphate and compost) and

Programme of work as sanctioned	Progress of work in 1954-55	Future programme of work in 1955-56
3. Study of formation of fibre layers in relation to plant height and base diameter.	phosphorus (from super phosphate) ; nitrogen both from ammonium sulphate and compost increased the total number of fibre wedges. Phosphorus does not affect the yield but increases the density in a fibre wedge by increasing the number of layers.	Completed.
4. Routine identification of fibre samples.	Fibre samples received from different sources were examined and the required informations furnished.	To be continued.
III. Cytogenetics	Interspecific hybridization programme was carried out in details by using (a) different varieties of cultivated species at diploid level (b) different wild types of <i>C. olitorius</i> and <i>C. capsularis</i> at diploid level (c) wild and cultivated types of <i>C. olitorius</i> and <i>C. capsularis</i> at diploid level (d) autoteraploids of wild types and cultivated ones of <i>C. olitorius</i> and <i>C. capsularis</i> and their combinations with the diploids and (e) different wild species of <i>Corchorus</i>. A	
1. Interspecific hybridization.		

Study of factors involved in incompatibility between <i>C. capsularis</i> and <i>C. olitorius</i> in crosses.	Pollinated pistils of C.G. and D154 were cut and stained according to Foster's tannic acid-ironchloride method with Resorcin blue. Examination of the slides showed that the pollen tubes were well-stained.	To be continued.
2. Cytological studies.	Cytological studies of certain individuals of $2n \times 4n$ population of <i>C. olitorius</i> (C.G.) were practically completed.	Cytology of wild and cultivated types of <i>C. olitorius</i> and <i>C. capsularis</i> will be undertaken.
3. Colchicine treatment and X-irradiation on jute.	(i) Colchicine treatment of wild types of <i>C. capsularis</i> and <i>C. olitorius</i> was done. Autotetraploids have been obtained in both of them. (ii) Cytogenetical investigations of certain X-ray induced mutations in <i>C. olitorius</i> were completed. (iii) Pollen of <i>C. olitorius</i> and <i>C. capsularis</i> were X-irradiated with different dosages-600 to 1500 r units and were used in self and cross pollinations.	To be continued.
4. Pollen grain studies.	Comparative studies on the rates of the pollen tube growth of the two cultivated jute species were completed.	Completed.

Programme of work as sanctioned	Progress of work in 1954-55	Future programme of work in 1955-56
IV. Physiology 1. Investigations on the physiology of jute seeds. (i) Viability efficiency of seeds collected at different stages of maturity.	Pollen grain analysis of X-irradiated materials, colchicine treated plants and certain varieties of jute was done.	To be continued.
(ii) Investigations on the dual purpose of harvesting.	Further results were obtained in D154, Fanduk., JRC-212, C.G., JRO-632 and JRO-753. High percentage of germination was obtained in seeds collected from half-matured capsules. The results were correlated with different stages of harvest when seeds as well as fibre may profitably be obtained from the same plant. Field experiments were continued with D154, Fanduk, JRC-212, C.G., JRO-632 and JRO-753. They were harvested at three stages of maturity and the plants of each harvest were divided in the two lots. In one the whole plant was retted and in the second lot, the top-portion was removed for seeds and the rest was	To be continued.

retted. As in previous years the yield of fibre was slightly reduced, but a good quantity of seeds was obtained.	Well developed seeds were formed in winter in D154, JRC-212, C. G. and JRO-632 and these seeds gave normal performance when sown during season.	Work completed.
(iii) Performance of jute seeds collected from plants grown in off season in winter.	All the varieties within the same species showed identical nature of flowering. The seeds obtained at different stages in the flowering period were studied.	To be continued with seeds obtained at different times of the flowering period.
2. (i) Nature and range of flowering and seed formation in different varieties.	Seeds were grouped week-wise according to their development in the flowering period. They were sown in replicated plots in lines and the following data were obtained- (a) growth performance, (b) stripped weight method for fibre yield and (c) flowering habit from initiation of first flowering date.	To be continued.
(ii) Performance of seeds formed at different points on the flowering period.	The work was continued to find out the degree of response to temperature and different photoperiods in different varieties. Pre-sowing cold treatment alone brought about an earliness of 15-18 days in <i>capstularis</i>, while a lateness of about 8 days in <i>olitorius</i> varieties. The short photoperiods were effective in inducing	To be continued.
3. Effect of vernalization and photoperiods on the initiation of the reproductive phase.		

Programme of work as sanctioned	Progress of work in 1954-55	Future programme of work in 1955-56
4. Salt resistance.	significant earliness in both the species, while long day periods brought about a lateness by about a week. Field experiments in the saline region of Kakdwip could not be sown due to early drought and later flooding in the season. In trials at Nilganj, some resistance to salt was induced by pre-sowing treatment of the seeds with 0.5%, 1.0% and 1.5% NaCl solution. Seedlings were grown in different salt concentrations and the rate of transpiration was recorded. <i>Capsularis</i> (D154) showed less depression in transpiration rate than <i>olitorius</i> (C. G.). Wild varieties, <i>C. siliquosus</i>, <i>C. tridens</i>, and <i>C. trilocularis</i> were found to be more resistant than the cultivated <i>olitorius</i>.	To be continued.
5. Variations in growth and pattern of unit structures contributing the yield of fibre.	The results indicated that the rate of fibre layering was different in different varieties and this correlated with periods of active vegetative growth.	Completed.
6. Investigations on growth in different species and varieties.	The results obtained in all the important varieties, are now being tabulated and different correlations being worked out.	Completed.

To be continued in greater detail under field condition.

Based on the results of growth component experiments a new method of estimating fibre in green plants has been developed. To find out its practical application in introducing another criterion (fibre content) for selection in addition to basal diameter and height several estimations were made.

Completed.

The data on the distribution of pure fibre in relation to (a) total green weight, (b) total dry weight, (c) total bark weight and (d) total wood weight obtained during the previous year were analysed.

Completed.

A comprehensive account is in course of preparation.

Completed.

The rate of growth in length of different internodes beginning from the cotyledonary node has been recorded in D154, Fanduk, C.G. and R-26. It was found that longer internodes were found in *olitorius* varieties than in *capsularis* varieties.

To be continued.

Rate of growth of stalk and foliage at intervals of 49, 68, 88 and 111 days growth in different combinations of N,P and K was recorded. The specific differences in *capsularis* and *olitorius* with reference to foliage and stem relation and the retention capacity of the leaves on the stem was noted.

(i) Growth with reference to moisture content, bark, fibre and wood formation.

(ii) Percentage variation in distribution of pure fibre.

(iii) Ratio of bark formation to that of wood formation.

7. Linear growth of internodes and their distribution along the stem.

8. Growth in relation to stalk and foliage.

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9. Sand culture experiments at nutritional levels.	Preliminary experiments were conducted to find out in which nutrient solution jute plant grows well. The rate of vegetative growth, leaf output and initiation of flowering under different cultural conditions were recorded.	To be continued. Studies in the metabolic changes during the growth and maturity of the fibre.
V. Agronomy 1. Variety-cum-spacing-manurial trials.	In both <i>capsularis</i> and <i>olitorius</i>, the combined treatment effect was statistically significant and late varieties, D154 and JRO-632 proved superior to early varieties. Manurial responses were found to be more marked with early varieties than with late varieties.	Separate trials will be undertaken to study (i) the various spacings and (ii) the varieties and manures.
2. Manurial Trials. (a) Effect of N. P. & K.	Significant effects were obtained in various manurial treatments only in the case of <i>capsularis</i>. Application of N in combination with K increased the yield by 29% to 39% over the control. No significant responses were obtained in <i>olitorius</i> trials.	To be continued.

(b) Effect of organic and inorganic nitrogen.	Due to adverse weather conditions the <i>capsularis</i> crop was stunted and trial was abandoned. The differences due to various treatments were not significant in the <i>olitorius</i> trial.	To be continued.
(c) Effect of time of application of fertilizers in instalments.	In both <i>capsularis</i> and <i>olitorius</i> the application of ammonium sulphate at different stages of crop growth either in one application or in instalments was found to be insignificant.	To be continued in a modified form.
(d) Comparative merits of various Nitrogenous fertilizers on <i>capsularis</i> and <i>olitorius</i> jute.	The effects due to fertilizers were highly significant showing that the different sources of N behave differently. Ammonium sulphate gave significantly higher yields than Chilean nitrate, Urea, ammonium sulphate-nitrate and control. The varietal effect and the effects due to interaction (fertilizers & variety) were not significant.	To be continued.
(e) Comparative merits of organic manures against ammonium sulphate.	Oil-cake, compost and ammonium sulphate gave significantly higher yields than F.Y.M. and sludge in <i>capsularis</i>. In <i>olitorius</i>, the treatment differences were not so marked.	To be continued.
3. Manurial trials in States.	Simple manurial trials (modified on the basis of trends obtained from previous results) were conducted in both acid and non-acid zones in the cultivators' plots in various jute growing States.	To be continued.

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	In non-acid zone in Assam the yields from 30 lb. N + 40 lb. K_2O were as good as 30 lb. N + 40 lb. K_2O + 30 lb. P_2O_5 per acre. Effect of fertilizer was highly significant. In the State of Orissa 20 lb. N alone proved to be as good as higher doses of nitrogen either alone or in combination with P or K or both PK. In Bihar, the highest yield obtained was from application of 30 lb. N, 40 lb. K_2O and 30 lb. P_2O_5. In U.P., application of N singly or in combination with K or P or both was found to increase the yield of fibre. 20 lb. N proved as effective as 30 lb. N per acre. In West Bengal no trial was conducted.	
4. Triple cropping experiment on jute, paddy and pulses.	As the season was abnormally late, double and triple cropping with jute as first crop were not possible.	To be continued.

5. Date of sowing experiments.	In both <i>capsularis</i> and <i>olitorius</i> , April sowing gave the best result. Late varieties proved significantly superior to early varieties.	To be continued.
Green Manuring		
1. Maintenance and observation of species and varieties of Green Manure plants.	Plants raised from 37 different types collected were studied in observation plots.	To be continued.
2. Yield trial of types found promising as a result of the observations under item (1).	Kalikalai (<i>P. mungo</i>), sunnhemp and pillipesra were put in yield trial against cowpea and dhaincha. All these types gave equally good performance as compared to dhaincha and cowpea.	To be continued.
3. Preliminary studies on the possibilities of growing various green manuring crops in relation to its time of sowing between standing jute rows of different widths and crop (jute) ages.	G.M. crops sown between rows of standing jute of shorter height tended to give slightly better performance with sunnhemp, cowpea and kalikalai. Pillipesra gave encouraging results when sown in jute rows 15" and 18" apart.	To be continued.
4. The comparative efficacy of green manures alone or in conjunction with fertilizers and its effect on yield of paddy.	Under Nilganj conditions green manuring either alone or in conjunction with fertilizers did not have better effects on paddy than fertilizing paddy direct.	To be continued.
5. Study the optimum date of sowing and age of green	Early sown dhaincha alone gave the highest yield of green matter. Of the G.M. crops	To be continued.

Programme of work as sanctioned	Progress of work in 1954-55	Future programme of work in 1955-56
manuring crops for incorporation when sown pure or intercropped with jute in relation to yield of paddy.	sown between standing jute rows, cowpea gave better result than dhaincha so far as green matter was concerned. As regards the yield of paddy it gave equally good results as that of dhaincha and cowpea sown alone. All these treatments were found to be statistically superior to control.	To be continued.
6. Study of the above in relation to the yield of wheat.	An yield of 25.41 mds. of wheat, the highest per acre, was obtained when the crop was green manured with early sown cowpea. It was found to be statistically superior to the control. Of the G.M. crops sown between standing jute rows, cowpea gave better performance than dhaincha and it gave equally good results as that of dhaincha or cowpea sown alone so far as the yield of wheat was concerned.	To be continued.
7. To study the effect of green manures and other manures (boht organic and inorganic) on yield of paddy.	Treatments included application of fertilizers, oil-cake, F.Y.M., compost and sludge (at 20 lb. available N) directly to paddy. With regard to fertilizers, a mixture of ammonium sulphate, single super phosphate and muriate of potash was applied at the rate of 20 lb. N, 60 lb. P_2O_5 and 25 lb K_2O per acre. Dhaincha	To be continued.

Soil, biochemical and microbiological studies

1. Quality of fibre.

and cowpea were incorporated in the soil with and without the application of lime (200 lb. per acre). Highest yield was obtained from paddy when it was green manured with cowpea. The treatments, green manuring with dhaincha, application of F.Y.M., compost, sludge and oil-cake were also found to be significantly superior to the control.

To be continued.

The role of pH in determining the colour of the fibre along with of iron and tannic acid was further investigated.

Under semi-pilot scale, the cost of removal of 'shamla' colour by tamarind extract has been found to be ten annas per md. including the wages.

It was found that soil phosphorus may affect quality to a certain extent.

2. Retting of jute.

A. Action of different activators on retting of jute.

Large scale work on the effect of bone dust and ammonium sulphate has given encouraging results. Dhaincha or sunnhemp stems when put in bundles of jute stem, reduced

To be continued.

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B. Survey of retting water.	retting period under laboratory conditions. Attempts are being continued to find out the optimum concentration of the trace elements in reducing the retting period. 43 samples were obtained from different places and these were analysed. It was found that they were considerably rich in water soluble inorganic phosphorus.	To be continued.
C. Retting without steeping.	Work was continued with different organisms. The fibre obtained were coarse, not uniform in strength and were either rooty or barky.	To be continued.
D. Biochemical changes during retting.	Pectins and hemicelluloses were isolated and the influence of different micro-organisms on their decomposition were studied. It was found that there were two distinct pH ranges—one acidic (3-4) and the other neutral, where the retting period was the shortest.	To be continued.
E. Isolation of specific micro-organisms responsible for retting.	The cultures of the previous years were maintained and 2 new cultures were added. Several fungi collected from different sources	To be continued.

are being maintained for the study of the pectin and hemicellulose decomposing enzymes.	
3. Analysis of soils and manures for their chemical and mechanical constituents.	To be continued.
(a) Routine analysis.	
(b) Soil Survey.	To be continued.
4. Soil Exhaustion studies.	
A. Soil exhaustion studies in double cropping plots.	To be continued.
B. Soil exhaustion by different varieties of jute.	To be continued.
C. Changes in nutrient status of soils.	
(a) In heavily fertilised land.	To be continued.

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(b) Soil nitrogen. (i) Chemical.	Soil nitrogen (total and available) increased after cropping with jute not only in Barrackpore soils but also in soils (from different places) with which pot culture experiment was carried out.	To be continued.
(ii) Micro-biological.	It was found that sequence of change of soil-micro-organisms and different forms of nitrogen were more or less the same as that in previous year. Not only the age of the plant but weather also influenced the changes to a certain extent.	To be continued.
(c) Soil phosphorus.	In a pot culture experiment in which different types of soils were used, it was found that the available phosphate increased after a crop of jute.	To be continued.
D. Withdrawal of nutrients by the jute plants. (a) Accumulation of inorganic nutrient ions in the tip leaves (shoot apex).	It was tentatively found that beside other factors the accumulation of any particular nutrient ion was influenced by excess or deficiency of other ions.	To be continued.

(b) Uptake of nitrogen and other plant nutrients by the plant.	More nitrogen was found in the plant when nitrogenous fertilizers were added.	To be continued.
5. Development of methods for determination of soil nutrients for advisory work in connection with manuring etc.	The method of determination of available phosphate described previously was further standardized and an experiment was started to find out a suitable rapid method for the determination of available nitrogen.	To be continued.
6. Role of soil condition regarding susceptibility of diseases.	The influence of trace elements B, Zn, Cu, Mn, Mo and Co in the soil in producing diseases was studied.	To be continued.
7. Attempts to find out maximum production of jute under the influence of nitrogen.	The results were not statistically significant.	To be continued.
8. The influence of soil conditioners on soil textures.	Under Barrackpore condition (sandy loam) Krilium and Tamarind seed powder improved the water-holding capacity. Work was started with a heavy clay soil.	To be continued.
VII. Diseases		Study of the mode of infection including stomatal behaviour of different capsularis strains.
1. Study of the effects of environmental factors on secondary infection due to <i>Macrophomina phaseoli</i> .	Field records showed that pycnidia formation on plants of earlier sowings were not due to seasonal effects alone; the age of plant was also a factor.	

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2. Study of the stem-rot fungus.	Effects of light, temperature and different media on growth characters were studied. B45, B43 showed some special morphological features.	Pathogenicity of B46, B43 and B45 singly and in combination with the <i>Pseudomonas</i> and <i>Fusarium</i> isolated from potato fields, will be studied.
(i) Study of the different isolates of <i>Macrophomina phaseoli</i> and <i>Rhizoctonia</i>.	Pathogenicity tests with 7 different forms showed that B45 and B35 were slow to act while B43, B11 and B68 were very virulent.	Study of pathogenicity of the 8 forms against possible alternate hosts and jute seedlings.
3. Study of the biology of pathogens other than <i>Macrophomina phaseoli</i>.	Three selections proved to be fairly resistant. The intensity of attack was low.	Effect of seed-treatment on the incidence of anthracnose in seedling stage.
(i) Anthracnose of Jute.	3 isolates of <i>Colletotrichum</i> spp. were compared with the type culture of <i>C. capsici</i> from I. A. R. I. The one isolated from jute from Malaya somewhat agreed with the description of Ikata's <i>C. corchorum</i>.	Comparative study of the allied forms of <i>Colletotrichum</i> sp. isolated from different hosts for specific identification.

(ii) Soft-rot.	Effects of some soil correctives and fertilizers on the incidence of anthracnose were studied. In general incidence of soft-rot was low.	Study of the mode of infection. Study of general incidence.
(iii) Wilt.	It was found that the <i>Fusarium sp.</i> could infect the growing tip when the roots were injured by <i>Rhizoctonia</i> .	Study of pathogenecity. Efforts will be made for specific identification.
4. Investigations on chlorosis in jute.	Preliminary experiments indicated that chlorosis might be induced by smears.	Study of the technique of inoculation through smears.
5. Investigations on the methods of control of diseases.	59 selections were made from <i>capsularis</i> types. 10 selections from <i>olitorius</i> types were brought forward for multiplication.	(i) To be continued. (ii) Grading different types of jute according to susceptibility. (iii) Fresh crosses to be made.

Programme of work as sanctioned	Progress of work in 1954-55	Future programme of work in 1955-56
(ii) Relative resistance of different improved varieties.	JRC-1 was found to be susceptible to "Collar-rot" due to <i>Rhizoctonia</i> .	To be continued.
(iii) Studies on the relative efficiency of various commercial fungicides.	Bordeaux mixture, copper-oxide and colloidal copper were found better than others.	To be continued.
(iv) Effect of application of lime in root-rot areas.	The root-rot could not be completely eradicated. In the plots where lime was added incidence of root-rot ranged from 6 to 11 per cent.	Effect of different fertilizers on the incidence of diseases.
(v) Effect of rotating 'paddy-potato' for 2 years with 'Jute-potato'.	Incidence of root-rot in jute was reduced but not completely eradicated. Potato cultivation has an important bearing on the incidence of root-rot.	Study of other rotations.
6. Storage of Seeds.	Old seeds could be best stored in moisture-proof containers like "Alkathene" lined gunny bags. Old seeds could be used for cropping purposes after adjustment of seed rate.	Concluded.
VIII. Pests 1. <i>Nupserha bicolor</i> ssp. <i>post-brunnea</i> . (i) Varietal susceptibility of <i>olitorius</i> jute.		
	C. G. was found to be most susceptible to the attack of the pest, while R-26 and JRO-632 were comparatively less susceptible.	To be continued.

(ii) Effect of different levels of N, P, K and their combinations on incidence.	The differences were found to be insignificant.	To be continued.
(iii) Effect of variety-cum-spacing-cum-manuring on incidence.	There were indications that the pest preferred broadcast sown crops to those sown in lines.	To be continued.
(iv) Effect of degree of damage at different stages of growth on yield.	The crop was not uniform due to extreme soil heterogeneity. The trial was therefore rejected.	To be continued.
(v) Habitat of the pest during winter.	It was found that the pest during its pre-diapause stage cut the stem of the host plant at two levels—above and below its body length—and dropped down on soil from the host. The pest afterwards passes the winter in soil under the field condition, in diapause stage, encased in jute stem. Examination of thousands of olitorius stubbles indicated that the pest did not pass the winter in stubbles.	To be continued.
(vi) Diapause stage and soil depth.	Laboratory experiments showed that the diapause larvae could survive in varying depths of soil in jute stem casing. It could survive for about 4 months in soil even without the casing.	To be continued.
(vii) Factors eliminating diapause.	Investigations were in progress to find out factors responsible for eliminating diapause.	To be continued.

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(viii) Investigations on methods of Control.		
(a) Destruction of diapause stage.	Collection and destruction of diapause stage of the pest encased in small pieces of stem marked by the plugged ends, may be resorted to, as these may be found scattered on surface of the soil after the harvest.	
(b) Use of resistant type.	<i>capsularis</i> varieties have so far been found to be resistant to the pest.	Further observation will continue.
(c) Effect of insecticide as prophylactic.	The trial was not successful because of heavy mortality in the trial crop due to root-rot.	To be continued.
(ix) Parasites.	<i>Neocatolaccus</i> sp. was found to be the most important parasite of the pest having maximum activity during the month of August.	To be continued.
2. <i>Pseudococcus flamentus</i> var <i>corymbatus</i> .	The newly recorded pest caused serious damage to the stem of both <i>capsularis</i> and <i>olitornis</i> jute.	

(i) Phase responsible for damage.

(ii) Site susceptible to damage.

(iii) Effect of damage on the internodal length.

(iv) Effect of damage on height.

(v) Effect of damage on tissue.

Apion Corchori

3. Selection for resistance.

4 Time/dosage/instar/mortality/relationship.

First instar nymphs alone were found to be associated with damage.

The first instar nymphs can induce development of serious malformation when injury is done to the tip of the growing plant.

Damage inhibited length of internodes. Even the internodal length of the uninjured portion of a damaged plant was adversely affected.

Height of the affected plants was much arrested as compared to that of the normal plants.

Injury induces an increase in the number of cell layers and cell volume in cortex, xylem and pith.

Differences in selections, both *capsularis* and *olitorius*, were statistically insignificant. Fresh selections were made.

Work on the effects of different dosages of insecticides on different instars and the time taken for effecting mortality in different instars of the caterpillar pests were in progress.

Further observation will be continued.

Further observation will be continued.

To be continued.

To be continued.

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5. Extent of removal of vegetative matters by the caterpillar pests during their different instars.	Observations taken on different instars of <i>A. sabulifera</i> showed that the third instar larva is the most destructive.	To be continued.
6. <i>A. sabulifera</i> pH range of soil and pupa formation.	Preliminary observations were taken to determine the pH range of soil preferred by the last instar larva of the pest for the purpose of pupa formation.	To be continued.
7. <i>Hetrodera marioni</i>. (i) Depth distribution.	Studies made so far on the depth distribution of <i>H. marioni</i> indicated that a depth 6" below the soil surface was preferred by the pest.	To be continued.
(ii) Effect of DD on the pest.	DD as nematocide when applied @ 400 lb per acre at a depth of 6" from the soil surface can bring about 100 percent mortality in about a fortnight.	To be continued.
(iii) Effect of DD on plant growth.	Preliminary observations were taken to study the effect of DD on the crop. No immediate adverse effect was noticed on the	To be continued.

germination or on the seedlings of *capsularis* or *olitorius* jute.

X. Substitute Fibres.

Botanical and agronomical studies

A. Botanical studies.

1. Collection of types.

To be continued.

39 fresh samples of seeds and other propagable materials of different fibre crops, both indigenous and exotic were received during the period.

2. Breeding of *Hibiscus*.

(i) Progeny-row tests.

To be continued.

Four progeny-row trials, two *cannabinus* and two *sabdariffa* were conducted during the year. Records of vigour performances and other characters were taken. 2472 secondary selections were made. The data of *cannabinus* trials could not be analysed due to wide variation in stands in different cultures caused by heavy stem-rot attack. Six promising cultures from the *sabdariffa* trials were carried forward.

(ii) Small scale trial of *H. cannabinus*.

To be continued.

The experiment was conducted as in previous years. The observed differences in yield of fibre were insignificant.

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(iii) Varietal trial of <i>H. sabdariffa</i> .	R. T. 26 has given the maximum fibre yield, but it is statistically at par with all the varieties except R.T. 40.	To be continued.
3. Genetics of <i>Hibiscus</i> .	In <i>Hibiscus cannabinus</i> 5 successful fresh crosses between flowers having white stigma and light pink centre of corolla with normal flowers were obtained. 36 F ₂ families and ten back-cross families were studied and 85 fresh crosses and 42 back-crosses were obtained in <i>H. sabdariffa</i> .	To be continued.
(ii) Inheritance of earliness.	10 back-crosses and 16 F ₁ selections of the last year's cross between early and late maturing strains of <i>H. cannabinus</i> and their parents were grown and studied. 19 fresh crosses between early and late strains of <i>cannabinus</i> and 16 back crosses were obtained during the year.	To be continued.
(iii) Leaf-shape character.	A monogenic difference was found between palmately-lobbed and partially-lobbed types of leaf in <i>H. sabdariffa</i> .	Completed.

(iv) Interspecific hybridization.	12 fresh crosses between palmately-lobbed and partially-lobbed type of leaf were obtained in <i>H. cannabinus</i>.	To be continued.
	F₁s of 66 interspecific crosses between <i>H. radiatus</i> and <i>H. cannabinus</i> were found to be highly sterile and the percentage of seed setting was very poor.	To be continued.
	The plants in 21 F₂ families of the cross between <i>H. radiatus</i> and <i>H. cannabinus</i> could not be classified due to very low population.	
	68 fresh crosses between different species of <i>Hibiscus</i> were obtained.	
B. Agronomical studies.		
(i) Date of sowing experiment.	This experiment was repeated with both <i>H. cannabinus</i> and <i>H. sabdariffa</i>. In <i>cannabinus</i> the trial failed due to heavy attack of various diseases and pests. In <i>H. sabdariffa</i>, the test was significant at 1% level and maximum plant height, base diameter and fibre yield were obtained in the sowing of 1st week of March.	To be continued.
(ii) Seed-rate experiment with <i>H. cannabinus</i>.	The test was highly significant. Maximum fibre yield was obtained in the seed-rate of 20 lb. per acre.	To be continued.

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(iii) Seed-rate experiment with <i>H. sabdariffa</i> .	Significant differences were found amongst different seed rates with respect to stand per acre, average plant height, base diameter of plants and fibre yield. Mortality of plants increases with the gradual increase in seed rate.	To be continued.
(iv) Spacing trial with <i>H. sabdariffa</i> var. <i>Altissima</i> .	The test was highly significant. For a particular spacing between lines, the spacing of 6" within line has given greater plant height, base diameter and fibre yield than spacings of 2" and 4". With the increase of spacing within the line the mortality of plants also decreased.	To be continued.
(v) Manurial trial with <i>H. sabdariffa</i> .	The test was insignificant like last year.	To be continued.
(vi) Combined yield trial of different fibre crops.	The test was significant at 1% level. Roselle—both green and green-pigmented types have given significantly higher yield of fibre than all the other crops included in this trial.	To be continued.
C. Studies on other fibres. (i) Sunnhemp.	Morphological characters of the different	To be continued.

collections of sunnhemp and species of *Crotalaria* were recorded.

In a Sunnhemp varietal trial conducted in U.P., K.12 and S.T.112 gave significantly higher yield than the two local strains.

To be continued.

(ii) Linseed.

Records on various morphological and physiological characters in type collections of Linseed were taken.

Yield trial of Linseed had to be abandoned due to levelling work of the farm.

To be continued.

(iii) Ramie.

Further additions to the existing collections of ramie slips and seedlings were done.

Small quantity of Ramie ribbon was decorticated by 'Baproma' decorticating machine.

To be continued.

Fresh suckers of *A. sisalana* and *A. veracruz* were received from Orissa and Ranchi respectively. Almost all these suckers have struck roots in the nursery plot.

To be continued.

(iv) *Agaves* and *Furcraeas*.

Seeds of different fibre crops were multiplied on a small scale.

D. Seed multiplication.

Programme of work as sanctioned	Progress of work in 1954-55	Future programme of work in 1955-56
II. Anatomical and cytological studies. A. Anatomy 1. Study of distinguishing features of fibre bundles in substitutes and characteristics of ultimate fibre cells. 2. Leaf and fibre development in <i>Agave</i> spp. B. Cytology.	The characteristics of the fibres were studied by treating with sulphuric acid and by chemical sectioning. It was found that in mesta and roselle there were 20-30 layers in the secondary wall of the fibre cell, as in the case of jute. (i) Stem tips of <i>Agave cantala</i> and <i>Agave sisalana</i> were sectioned and studied. Work was in progress. (ii) Number of fibre bundles per unit area of the leaves of different species of <i>Agave</i> was studied. (iii) Length and breadth of ultimate fibre cells of the leaves of different species of <i>Agave</i> were measured. Work was in progress. Fixation of pistils at different intervals after pollination in some of the fresh interspecific	To be continued. To be continued. To be continued.

crosses was in progress. Germination count of pollen grains of different fibre crops in culture media was started. Fixation of flower buds for cytological study was in progress.

Colchicine treatment in the hybrid seeds of the interspecific crosses of *Hibiscus* was done. Seeds of 9 F¹ selections treated with colchicine have been carried forward.

III. Diseases and Pests.

A. Diseases.

1. Mesta.

(a) Virus diseases—Virus A.

Incidence of diseases in different selected types will be studied.

(b) Stem-rot.

Selected materials have been grown under optimum condition of infection. Further selections were made.

Pure cultures of the pathogens will be studied.

(c) Root-rot.

The incidence of stem-rot due to *Helminthosporium* were recorded.

Effect of different fertilizers and soil corrective.

(d) Brown-rot.

The Rhizoctonia causing root-rot has been found to attack jute.

Concluded.

2. Sunn-hemp.

Due to mixed infection the study had to be abandoned.

Incidence of wilt in the type K12 will be studied.

Programme of work as sanctioned	Progress of work in 1954-55	Future programme of work in 1955-56
3. Roselle.	Incidence of <i>Phoma sabdariffa</i> was uniform in all the treatments of different doses of fertilizers.	
4. Furcraea.	The plants were transferred from nursery bed. The crop was healthy. Incidence of anthracnose disease was low.	Routine observation of incidence of diseases.
5. Ramie.	<i>Alternaria</i> sp. and <i>Curcularia lunata</i> were isolated from the affected leaves; infection was widespread.	Routine observation of general incidence of diseases.
B. Pests.		
1. <i>Agrilus acutus</i>		
(a) Biology of the pest.	Preliminary observations showed that there was no influence of geotropism on the larval activity.	To be continued.
(b) Effect of different dates of sowings on the incidence of the pest.	Crops (<i>H. cannabinus</i> and <i>H. sabdariffa</i>) sown during second part of April to first part of May were attacked more by the pest. Crops sown before the middle of March were not attacked. Incidence of the pest was much less in <i>H. sabdariffa</i> than in <i>H. cannabinus</i> .	To be continued.

(c) Difference of incidence in varieties.	No significant difference in incidence was observed amongst the four varieties of <i>H. cannabinus</i> or amongst the six varieties of <i>H. sabdariffa</i> . Incidence on <i>sabdariffa</i> varieties was much less than in <i>cannabinus</i> varieties.	To be continued.
2. Transmission of mesta virus.		
(a) Seed transmission.	Progenies from virus affected plants kept free from insect attack by frequent application of insecticides, were almost free from virus attack suggesting that the disease may not be seed transmitted.	To be continued.
(b) Insect transmission.	Insect transmission tests could not be carried out for want of suitable facility. <i>Empoasca devastans</i> and white flies were used in the test. Results were inconclusive.	To be continued.
XI. Extension work.		
1. Demonstration of improved methods of jute cultivation in cultivators' plots in 3 centres at Barrackpore, Baraset and Basirhat.	Improved techniques were demonstrated in 72 plots selected in cultivators' area. Data regarding enquiry into Agro-economics of the jute cultivators of the three extension centres (1954-55) was collected.	To be continued.
2. Demonstration of improved methods of jute cultivation in cultivators' plots in one Development Block at Nilganj.	Selection of sites for demonstration plots was completed.	Demonstration of improved methods of jute cultivation in plots in Nilganj Development Block.

